The Research Quarterly

of the American Association for Health, Physical Education, and Recreation

MARY WIBEL, *Editor*

VOLUME 15 **OCTOBER, 1944** NUMBER 3

Contents

Published in March, May, October, and December by the American Association for Health, Physical Education, and Recreation, 1201 Sixteenth Street, N.W., Washington 6, D. C. Subscription, $3.00 per year; single copies, $1.00.

Send subscription to: 1201 Sixteenth Street, N.W., Washington 6, D. C.

Editorial and Advertising Office: 1201 Sixteenth Street, N.W., Washington, D. C. Advertising rates on application.

Entered as second-class matter at the Post Office at Washington, D. C., under the act of March 3, 1879.

Life and Honorary Members

American Association for Health, Physical Education, and Recreation

Ainsworth, Dorothy, 15 Barrett Place, Northampton, Mass.

Anderson, Lt. Jackson M., Special Service Officer, A.A.B., Dalhart, Texas.

*Anderson, W. G., Box 1911, Yale Station, New Haven, Connecticut.

Bell, Margaret, University of Michigan, Ann Arbor, Michigan.

Bookwalter Karl W., Indiana University, Bloomington, Indiana.

Booth, Minnie Anne, 135 Navarre St., Rochester, N. Y.

*Day, William E., 1377 Princeton Ave., Salt Lake City, Utah.

Delta Theta Epsilon, University of Illinois, Urbana, Illinois.

Di Giovanna, Vincent, Southern Illinois Normal University, Carbondale, Ill.

Dupain, George Z., Rose Bank, 158 Parramatta Road, Ashfield, N.S.W., Australia.

Elliott, E. S., Columbia University, New York City.

Friermood, Harold T., Y.M.C.A., 347 Madison Ave., New York City.

Fulton, Ruth E., 1230 Amsterdam Ave., New York City.

Gates, Grover, 835 Hampton Way, Fresno, California.

Giauque, Lt. Comdr. C. D., Sampson, N. Y.

Hansma, Lt. Jack, 9th Technical School Squadron, Fort Logan, Colo.

Hill, Laurence S., Ithaca College, Ithaca, N. Y.

Houston, Ruth, State Teachers College, Buffalo, New York.

Howe, Arthur L., Hamburg, New York.

Knoff, Daniel H., Ada, Minn.

Langton, Clair V., Oregon State Agricultural College, Corvallis, Oregon.

Lee, Mabel, University of Nebraska, Lincoln, Nebraska.

Luehring, F. W., 435 Riverview Rd., Swarthmore, Pa.

Mackey, Anne D., 38-30 211 Street, Bayside, L. I., N. Y.

McCloy, C. H., State University of Iowa, Iowa City.

*McCurdy, Mrs. Persis B., 79 Lawn Ave., Middletown, Conn.

McKinstry, Helen, Russell Sage College, Troy, New York.

Metcalf, T. N., University of Chicago, Ill.

Miller, Ben W., 1201 16th St., Washington, D. C.

Mitchell, Lt. Comdr. E. D., New Orleans, La.

Moore, James B., Route 1, Box 123, Escalon, Calif.

Moore, Rodgers, 1859 26th, San Francisco, Calif.

Moorhead, W. G., 121 Center Street, East Stroudsburg, Pa.

Moulton, Gertrude E., 291 Forest Ave., Oberlin, Ohio.

Neilson, N. P., University of Utah, Salt Lake City, Utah.

Norris, J. Anna, 1429 East River Road, Minneapolis, Minn.

Noyes, Elizabeth, ARC, A.P.O. 565, c/o Postmaster, San Francisco, Calif.

Panzer College of Physical Education and Hygiene, 139 Glenwood Ave., East Orange, N. J.

Posse, Baroness Rose, Shelton Hotel, Lexington Ave. at 48th St., New York City.

Rugen, Mabel, University of Michigan, Ann Arbor, Michigan.

Schnell, H. W., University of North Carolina, Chapel Hill, North Carolina.

Scott, M. Gladys, State University of Iowa, Iowa City, Iowa.

Siler, J. Granville, 2574 Hilgard Avenue, Berkeley, Calif.

Sparks, Lestle J., Willamette University, Salem, Oregon.

Stafford, Grace M., N.Y.A., 611 Arlington Place, Chicago, Ill.

*Stecher, William A., 1510 Darby Road, Upper Darby, Pennsylvania.

Steinhaus, Arthur H, U. S. Office of Education, Washington, D. C.

Streit, William K., Board of Education, Cincinnati, Ohio.

Swain, Leslie E., Brown University, Providence, Rhode Island.

Tarr, Edna V., 606 Logan St., Toronto, Ontario, Canada.

Walker, Charles L., c/o R. L. Walker, 408½ S. Queen St., Lancaster, Pa.

---

*Honorary Members

Studies In Physical Efficiency of College Students

By Lucien Brouha, Norman W. Fradd, and Beatrice M. Savage

The Grant Study, Hygiene Department
and
The Department of Physical Educat on
Harvard University
Cambridge, Mass.

(Submitted for publication, March, 1944)

"PHYSICAL efficiency" and "physical fitness" are terms which have been used rather loosely to describe studies quite different in extent; but to be used accurately and to have a precise meaning, these terms must be clearly qualified.

For present consideration, three main aspects of *physical fitness* are defined at the outset: (a) *medical fitness* or good health, which concerns a sound body—good heart, good lungs, good muscles, good teeth, etc. This aspect is what interests the majority of physicians, and upon them lies the entire responsibility of deciding whether an individual is healthy, or medically fit. (b) *Functional* or *dynamic fitness* or the ability to sustain strenuous exercise and to recover from it rapidly. Such fitness implies that the general physical machinery is working well, that there is an efficient blood circulation, a sound respiratory mechanism, and good muscular coordination. (c) *Specific fitness,* or fitness for various forms of specific muscular coordinations, skills, and strengths, such as runn'ng, jumping, climbing, throwing.[1] * *

Once a man has been determined to be *medically fit,* it is of the utmost importance to measure both his dynamic fitness and his specific fitness in order to judge his physical efficiency and the effectiveness for him of a particular training program. Various tests have been devised for measuring specific fitness, or special skills and strength. These are based upon a variety of exercises such as push-ups, chin-ups, high jumps, rope climbing, etc. Dynamic fitness, however, is less simple to estimate because it involves the knowledge of the functional capacity of various physiological mechan-

The authors wish to express their appreciation for the valuable assistance given to them by Dr. C. W. Heath, Mr. T. E. Bolles, Mr. Jaako J. Mikkola, Mr. A. W. Samborski, Mr. F. S. Stahl, and the members of the staff of the Department of Physical Education.

*** Superior figures refer to numbered bibliography at end of article.**

isms when placed under the stress of muscular activity. Laboratory experiments have successfully measured this functional fitness through the use of elaborate techniques which include measurements of heart rate, blood pressure, pulmonary ventilation, oxygen consumption, blood sugar, and blood lactate variations, in relation to various kinds of work. But, for practical use, these techniques have to be drastically simplified. In 1928 A. V. Bock and his coworkers found that during exercise "the pulse curve alone quite accurately depicts the physical state."[2] Further research[3, 4] following this basic premise led to a simple means of measuring a man's efficiency for hard muscular work.[5] A reliable and rapid method of testing dynamic fitness was evolved[6] which has been in use now at Harvard College since 1942 to check the functional efficiency of various groups of men already determined to be medically fit. In the present paper this method is briefly summarized and data are given which show both the results of the initial tests and the effect of training on the dynamic fitness of various groups within the college population.

METHOD OF TESTING

A natural type of exercise is used in which each subject works at a constant rate and proportionally to his body weight. Since the exercise involves large muscle groups, the cardiovascular and respiratory systems are placed under definite stress. The subject steps up and down 30 times a minute on a 20-inch platform. The exercise is continued for 5 minutes unless the subject stops from exhaust on before the termination of that period. The pulse is counted from 1 to 1½, 2 to 2½, and 3 to 3½ minutes after the exercise is discontinued, and the index of physical efficiency is computed as follows:

$$\text{Index} = \frac{\text{Duration of exercise in seconds} \times 100}{2 \times \text{Sum of pulse counts in recovery}}$$

Pulse before exercise need not be taken. It has been shown that, in general, neither the basal pulse nor the sitting pulse before the test has any significant relation to an individual's performance capacity nor to his physical fitness index.[1, 7]

On the basis of about 8,000 tests carried out on college students and college athletes, the significance of this index in young men has been found to be as follows:

Below 55 = Poor physical condition
From 55 to 64 = Low average
From 65 to 79 = Average
From 80 to 89 = Good
Above 90 = Excellent

SECTION 1. PHYSICAL EFFICIENCY OF VARIOUS GROUPS OF YOUNG MEN

A. Fitness of the College Population

During 1942 the test just described was given to 2,167 students in Harvard College, regardless of their training condition or of their participation in athletics, intramural sports, or the conditioning program. Thus, the group was representative of the college population as a whole and included men of low physical efficiency who were in the "Special Exercise" class as well as varsity athletes who were in full condition. Figure I gives the distribution of the scores obtained in this survey. It is seen that scores as low as 15 and as high as 155 were recorded. The average for the entire group was 75.

Ten per cent of the men were in poor physical condition (i. e. scoring below 55), 55 per cent were average (55-79), 24 per cent were good (80-89), and 11 per cent were in excellent physical condition (scoring above 90). The majority in this last group were varsity and junior varsity athletes or students who were engaged regularly in sports, games, or outdoor activities.

B. Fitness of Various Student Groups

Freshmen.—The test was given routinely to all freshmen within the first week after entering college. Table I shows that the class entering in June, 1942, had an average fitness index of 69; for the class coming in September, 1942, the average index was 72; and for the class entering in February, 1943, the average increased to 80. This improvement in the average fitness of boys at the time of entering college is attributed mainly to two factors: a stiffer program

TABLE I

Physical Fitness Indices of Various Groups of College Students

Group	*Number*	*Mean Score*	*Range of Scores*	*Per cent Below 55*	*Per cent 55 to 79*	*Per cent 80 to 89*	*Per cent 90 and over*
Entire College	2167	75	15-155	10	55	24	11
Freshmen, June, 1942	485	69	17-114	18	63	15	4
Freshmen, Sept., 1942	739	72	15-104	12	61	21	6
Freshmen, Feb., 1943	78	80	31-107	2	45	35	18
Freshmen, June, 1943	465	69	25-97	12	74	12	2
Sophomores ('46)							
Juniors ('45)							
Seniors ('44), June, 1942	418	73	25-101	9	67	20	4
ROTC Seniors, July, 1942	106	81	65-104	0.0	51	37	12
ERC, July, 1942	119	74	32-102	14	52	25	9
Athletes, 1942	125	93	70-156	0.0	9 (70 to 79)	37	54

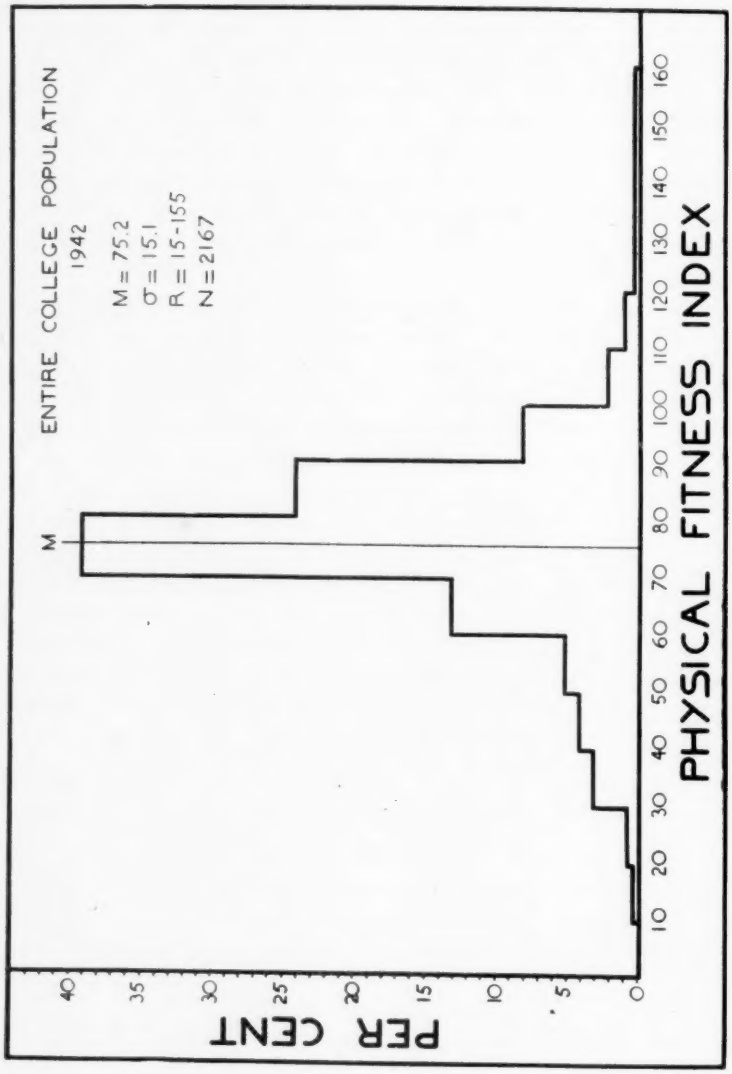

Figure 1. Distribution of physical fitness (by per cent) of college population.

of physical training during the last year of high school, and the desire on the part of the boys themselves to be in good condition before being called to the armed forces. The average fitness score for the class entering in June, 1943, fell back to 69. Many of the students in this group, however, were but 17 years of age, or even less. Thus they were younger and less mature than those in previous groups. Furthermore, boys classified as 4-F were in this group and their performance would contribute naturally to a lowering of the average.

ROTC Students.—One hundred and six Harvard ROTC seniors were tested as a group. The average fitness score was 81, with a range of 65 to 104. This would indicate that all these officer candidates were high average, good, or excellent in physical fitness.

Forty-five ROTC sophomores were also checked as a group. They earned an average score of 79 with a range of 66 to 102, which is quite comparable to the senior group.

Similar ratings were made on 119 candidates for the Enlisted Reserve Corps at Harvard. This group earned an average score of 74 with a range of 32 to 102. Those candidates whose scores showed them to be in poor physical condition were rejected. The average score of the successful candidates was 79, with a range of 65 to 102, which compares favorably with the ROTC groups.

Thus, it is seen that highly selected groups for which a satisfactory level of fitness is a prerequisite, like the ROTC and ERC, have a smaller range of fitness scores and a higher average score than is found in unselected groups. (Refer to Figs. 1 and 2).

College Athletes.—This finding is even more str king when the preceding groups are compared with a still more highly selected group of 125 qualified college athletes. At the time of their examination not all of these men were in full training but all were phys.cally active. The average score for the athletes was 93, none scoring under 70; 37 per cent were good and more than half, or 54 per cent, were excellent, scoring better than 90. (See Table I.) As would be expected, the highest indices recorded were among this group.

Comparable results obtained with the 1943 athletes for various types of athletic act vities as follows:

TABLE II

1943 ATHLETES

Activity	*Number*	*Average Index*	*Score Range*
Baseball	23	90	79-103
Track	22	95	75-108
Track (Freshman)	41	88	76-113
Crew (Varsity)	8	109	92-129
Crew (Freshman)	8	85	76-96

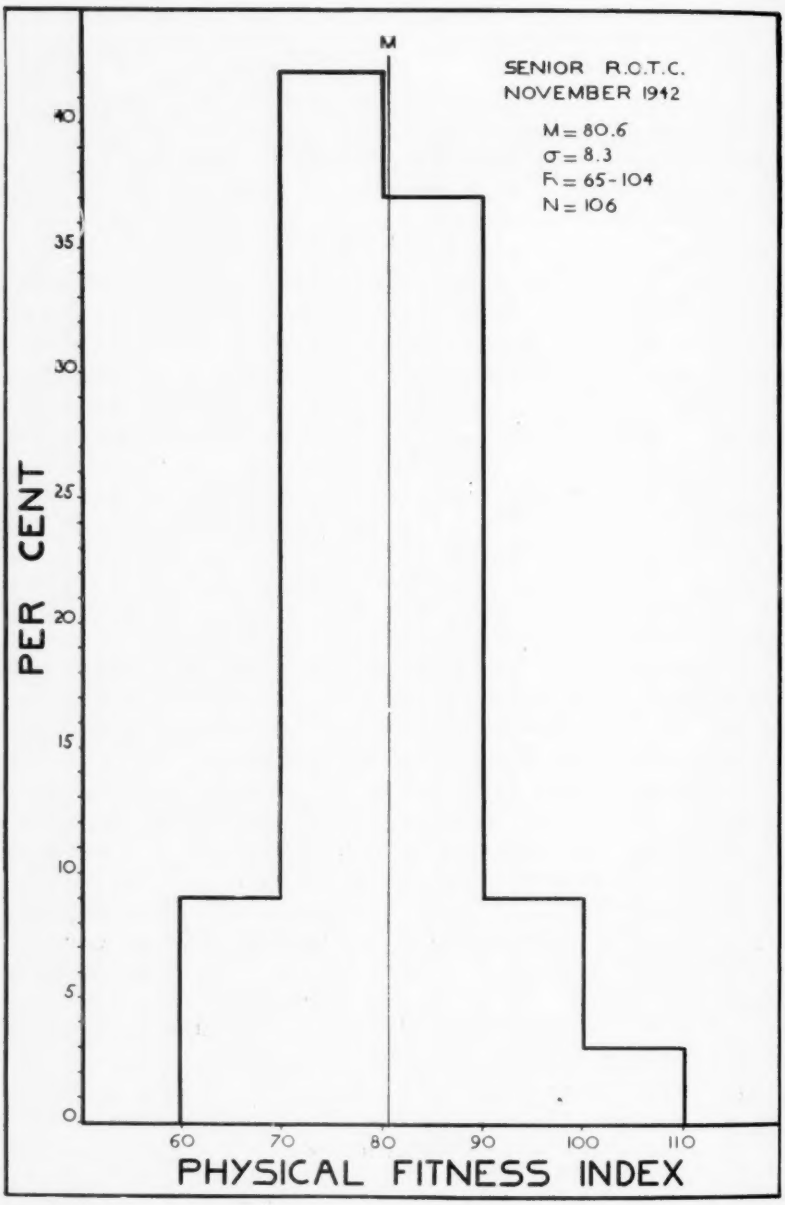

Figure 2. Distribution of physical fitness scores (by per cent) of ROTC students.

SECTION II. EFFECTS OF TRAINING ON PHYSICAL EFFICIENCY

In order to observe the changes in physical efficiency, as measured by this test, series of studies were made on various undergraduate groups. The results of two of these studies are cited below: (a) a group of athletes (varsity and junior varsity) whose ability to perform hard muscular work was well known from their actual performance in college sports; and (b) a group of entering freshmen whose physical abilities were not previously known.

A. College Athletes

Crewmen and cross-country runners were tested before, during, and after their training periods. The average index of 22 qualified oarsmen was 87 before training with a spread in scores from 65 to 105. During their training period when these men were in full condition, the average index increased to 103 with a score range of 75 to 181. At the end of the 1942 season, the unbeaten varsity crew had an average score of 113, with a range of 91 to 181 and the junior varsity crew had an average index of 95 with a range of 75 to 108. Similarly the average score of the cross-country runners was 86 before training and improved to 97 when in condition, with a range of 82 to 125. All the individual scores improved, most of them quite markedly. After breaking training, the scores of many of these athletes dropped to a level of 75 to 80, showing that even the best men cannot maintain their maximum fitness unless under appropriate training.

B. Freshmen

As previously stated, this test was given routinely to all entering freshmen. Of the group entering in June, 1942, ($N = 485$) 331 were retested three months later after a twelve-week training program of four hours a week.

In this program, each student who had scored at least 75 on his test was free to choose his four hours of exercise from the entire sports calendar. If he was on a squad participating in outside competition, the practice schedule of that particular squad gave him his credits. The choice of tennis or squash gave him only 2 credits a week and he had to earn the other 2 in another sport, such as swimming, crew, conditioning, etc. Students carrying a heavy scholastic load were excused from one or more hours of required exercise. They had to get their credits by attending conditioning classes, which consisted of marching, calisthenics, combatives, and running.

The students who had scored under 75 on the test were required to take 4 hours of special conditioning per week until they could

reach a fitness index of 75 or better. These conditioning classes gave a variety of work, increasingly strenuous, as the weeks advanced. The program was divided into military marching, calisthenics, stunts, obstacle course (100- and 300-yard courses), landing nets, running various distances up to one mile, combatives (boxing, wrestling, commando tactics), rope climbing, and elementary tumbling. Achievement tests to follow improvement in fitness were given.

In June the average index for this group was 69 with a score range of 17 to 114. Eighteen per cent scored below 55, which classified them as in poor physical condition; 63 per cent were average, 15 per cent were good, and 4 per cent earned the rating of excellent. Twenty-two per cent were unable to complete the entire five minutes of the test. In September the average index had improved to 76 with a score spread of 19 to 107. This time only 9 per cent were not able to complete the five minutes. Seven per cent still had a score below 55, 55 per cent were "average," 29 per cent were "good," and the per cent of those scoring above 90 had more than doubled (9 per cent).

When the scores are considered individually, it is seen that 244 of the group, or 74 per cent, improved their fitness during the twelve-week period, the average gain in score being 11.3 points. Twenty-two men (7 per cent) held the same score and 65 men (19 per cent) got a lower score on the second test. Among those who got a lower score on the second test, the average loss was but 4.5 points, only 10 per cent losing 5 points or more. For practical purposes, it has been found that a score difference of 4 points is of little significance because such a difference might well be within the range of daily variation.

TABLE III

AMOUNT OF GAIN OR LOSS AFTER 3 MONTHS' TRAINING—331 FRESHMEN JUNE-SEPTEMBER, 1942

Change in Score between Tests I and II *Points*	*Per Cent of Individuals*	
+ 50 to + 59 points	.3	
+ 40 to + 49 "	.9	
+ 30 to + 39 "	4.5	74%
+ 20 to + 29 "	8.5	
+ 10 to + 19 "	15.7	
+ 1 to + 9 "	43.8	
0	6.7	7%
— 1 to — 4 "	9.6	
— 5 to — 9 "	6.4	19%
— 10 to — 19 "	2.4	
— 20 to — 29 "	1.2	

It should be mentioned that the group of students who lost between the two tests includes boys who were excused from athletics or conditioning on account of illness or minor injuries. Table III shows the amount of point gain or loss between Test I and Test II.

Table IV presents these gains and losses on Test II in relation to the initial index the individual earned on Test I.

TABLE IV

CHANGE IN SCORE AFTER TRAINING IN RELATION TO INITIAL SCORE—331 FRESHMEN—JUNE-SEPTEMBER, 1942

Initial Score	*Number of Individuals*	*Second Score Improved Per cent*	*No Change Per cent*	*Decreased Per cent*
10 - 19	2	100	0	0
20 - 29	7	86	14	0
30 - 39	14	93	7	0
40 - 49	26	96	0	4
50 - 59	27	93	0	7
60 - 69	56	75	9	16
70 - 79	139	74	7	19
80 - 89	48	52	6	42
90 - 99	7	29	14	57
100 - 107	5	20	20	60

It is seen that under these training conditions, the majority of the students scoring less than good (80) in June improved their scores. Among these who were good when entering college (80-89), 52 per cent improved and 42 per cent lost. Among those who were excellent (90+), the majority lost. These findings would indicate that the training program was better adapted to the lower level of fitness of the group; that it was not hard enough for the men who were already in good condition and consequently their fitness indices were less good on Test II than on Test I. Had these students been submitted to a training program comparable to that of the athletes, many of them might have been able to maintain or even improve their level of fitness, as judged by the observations made on various groups of athletes with high initial scores.

C. FRESHMEN—WEAK SQUADRON

On the basis of these findings, it was decided to separate the next freshman class, entering in September, 1942, into three physical training groups according to their fitness scores at the time of entrance, the groups to be as follows: (1) those men who did not score above 55 were to be assigned to a "Special Exercise" class; (2) those who scored from 56 up to, and including, 75 to be put in "Conditioning" classes; and (3) those above 75, or better than the

1942 college average, were to be free to select their own type of physical train.ng.

In this group of 739 freshmen, there were 330 who scored 75 or under and therefore were assigned either to the Special Exercise or the Conditioning Class. The work of the conditioning class has already been described (Section II, B). The men assigned to the Special Exercise group worked four hours per week in the Special Exercise Room at the Gymnasium. Their program was built around a variety of heavy abdominal and back exercises, with stall bar work using stools and suspension. This work was carried on in groups of not more than 30 men, finishing the work-out with an outdoor mile run.

The average score for the men in these two groups was 64 with a score range of 21 to 75. On the retest, after a twelve-week training period, the average index improved to 71 with a range in score from 30 to 94. On this second test 36 per cent of the group were able to score better than 75, 6 per cent dropped from 5 to 15 points, 38 per cent fluctuated between +4 points and —4 points, while 56 per cent gained from 5 to 50 points. Table V shows that after training this "Weak Squad" was able to bring its average score w.thin one point of the average of the entire class on entering.

TABLE V

SCORES OF THE FRESHMAN CLASS OF SEPTEMBER, 1942, AND OF THE "WEAK SQUAD" OF THAT CLASS IN SEPTEMBER AND IN DECEMBER, 1942

	Number	*Mean*	*Range*	*Per cent Below 55*	*Per cent 55-79*	*Per cent 80-89*	*Per cent 90+*
Whole Class	739	72	21-104	12	61	21	6
Weak Squad September	330	64	21-75	23	77 (Upper Limit—75)		
Weak Squad December	330	71	30-94	11	62	16	10

A similar procedure was carried out with the freshman class which entered in July, 1943. At the time of entrance the average fitness index for these 405 freshmen was 69 with scores ranging from 25 to 97. There were 244 in the group who scored 75 or less, the average of this "Weak Squad" being 65, with scores ranging from 25 to 75. As with the "Weak Squad" of the previous group, these men were assigned either to Special Exercise or Conditioning Classes, according to their scores. This time the retest was made after an eight-week training period, at the end of which the average score of this group had improved to 75, or 6 points above the average score for the whole class when entering. On the second test 46 per cent of the originally "Weak Squad" were able to score above 75, while another 13 per cent scored at 75. The range of scores at this

time was from 25 to 102. When the scores on the first test and retest are compared indiv dual by individual, there are none who score below 70 on the initial test who lost on the second test, as seen in Table VI.

TABLE VI

CHANGE IN SCORES OF WEAK SQUAD OF JULY, 1943, FRESHMEN AFTER TRAINING

Score on Test I (July 1943)	*Number*	*Per Cent Improved*	*Change on Test II (September 1943) Range of Pt. Gain*	*Per Cent Same Score*	*Per Cent Poorer Score*
25-20	2	50		50	0
30-39	16	81	10-45	19	0
40-49	9	100	4-31	0	0
50-59	23	96	5-40	4	0
60-69	87	100	1-34	0	0
70-75	105	86	1-20	5	9*

* A single individual dropped over 5 points.

D. SPECIAL GROUP FROM A "WEAK SQUAD"

A further follow-up was made of 123 men of the "Weak Squad" from the September, 1942, freshmen. These men were tested a third time in March, 1943, after a total of 6 months of special training. On the initial test in September, the average index of this group had been 63; in December they had brought it up to 71; and in March it had improved to 74. At the end of this six months' period, as many as 21 per cent earned scores which placed them in the classification of "good" and 4 per cent scored above 90, which classified them as "excellent."

A more detailed study of the changes which occurred in the fitness of these men during this period would substantiate the theory that in order to improve fitness, the best results are obtained when men of *approximately the same physiological efficiency* are put under a suitable training period. In other words, when the range of fitness in a group is too wide to begin with, the training program cannot be properly balanced to benefit the poor and the good at the same time.

Certain figures concerning this special group of 123 men are of interest as follows: After the first three months of training, 79 per cent of the group improved their scores, 8 per cent remained the same, and 13 per cent showed a lower score. (Refer to Table VII.) The average gain of the group was 7.8 points. The average gain for those who improved was 10.9 points and the average loss for those losing was 5.4 points.

After another 3 months of training, 90 per cent of the group had improved their scores, 2 per cent remained the same, and 7 per cent had lower scores. The average gain was 13.2 points and the average loss was 4.4 points. The average change in score for the group was

+11.6 points, bringing the average index to 74, a score within 1 point of the average of the college as a whole. This is a noteworthy achievement when it is recalled that before training, no individual in this group could score over 75.

During the training period between Test II and Test III, 66 per cent of the students improved their scores, 8 per cent did not change, and 26 per cent lost from 1 to 15 points. The average gain was 6.4 points and the average loss 4.2 points. The change for the

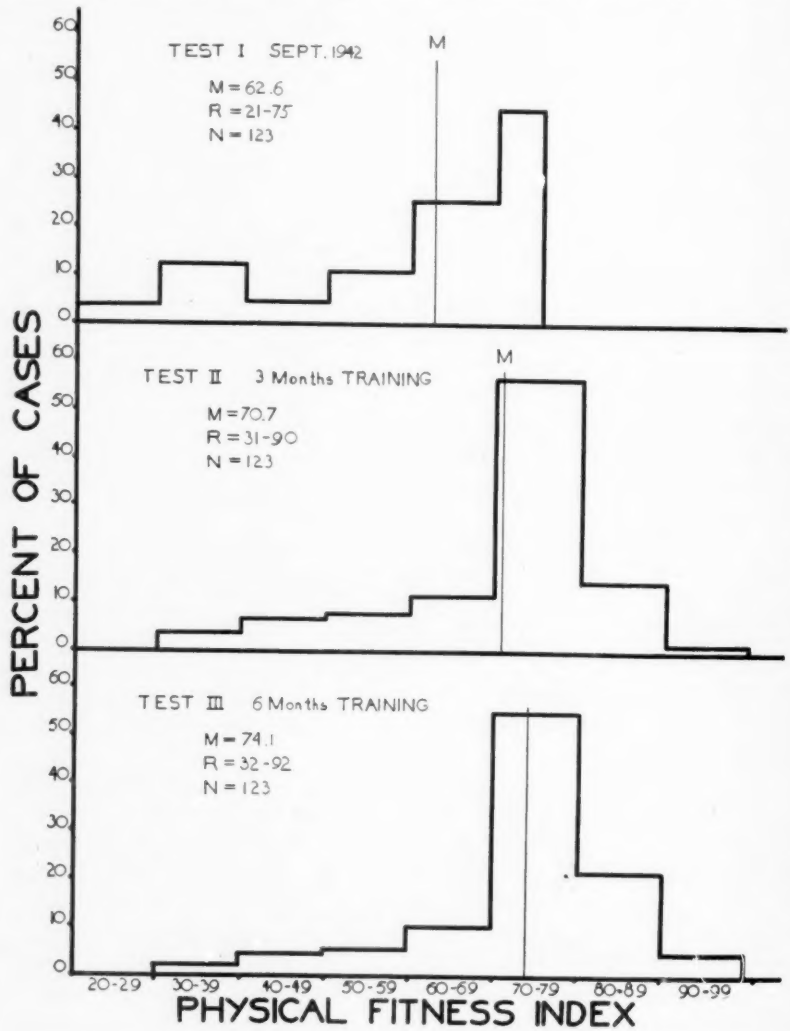

Figure 3. Distribution of physical fitness indices (by per cent) for Tests I, II, and III on 123 freshmen who scored 75 or under on Test I.

whole group was an average gain of 3.7 points. When comparing the two training periods, it is seen that more progress was made during the first: an average gain of 7.8 points for the first period against an average gain of 3.7 points for the second. Thus, a large proportion of the total improvement was achieved during the first part of the training program. Later on the progress is more slow, but, as shown by the final test, still consistent so that at the end of 6 months' training, the average is better than at any time before; more subjects have improved their fitness and a much greater proportion of them have reached scores above 80 (good) and 90

TABLE VII

VARIATIONS IN FITNESS INDICES OF 123 MEN OF THE WEAK SQUAD DURING 6 MONTHS OF TRAINING

Score Change (in points)	*Score Difference between Tests I and II, Sept.-Dec., 1942*		*Score Difference between Tests I and III, Sept, '42-March, '43*		*Score Difference between Tests II and III, Dec., '42-March, '43*	
	Per Cent of Individuals		*Per Cent of Individuals*		*Per Cent of Individuals*	
+50	0	78.8%	.8	90.3%	0	65.8%
+40 to +49	1.6		4.1		0	
+30 to +39	3.3		4.1		.8	
+20 to +29	8.1		9.0		1.6	
+10 to +19	22.8		29.3		17.1	
+1 to +9	43.0		43.0		46.3	
0	8.1	8.1%	2.4	2.4%	8.1	8.1%
−1 to −9	9.8	13.1%	6.5	7.3%	22.8	26.1%
−10 to −15	3.3		.8		3.3	

(excellent). Figure 3 presents the distribution curves of scores obtained on these three tests. As seen in this figure there is a small group who, even after a steady training program of six months' duration, are still low in physical fitness. The "tail" of these curves is always made up of the scores of the same individuals. Since all the men involved in this experiment were "medically fit," it appears that even among such a group a certain number are constitutionally unable to improve their general physical fitness, even to an average level. Such a consistently poor performance on the part of these individuals cannot be related in this instance to a lack of interest or cooperation since, according to their instructors, they were obviously interested in improving their own fitness. Thus, factors such as poor coordination, poor body build, and poor physiological efficiency seem to be responsible for the lack of improvement in these men.

CONCLUSIONS

The findings from this series of experiments are consistent with conclusions as follows:

1. The fitness index, earned by means of the Step-Test technique, gives a suitable indication of the physical efficiency of young men because, among other reasons, it improves under regular training, and declines when training is insufficient or wanting.

2. Among young men who are medically fit, wide differences in physical efficiency are observed in the spread of fitness scores; the average index is higher and the spread of scores is smaller among men who regularly engage in various forms of muscular activity; the highest indices are obtained by athletes in training, whose actual performance proves their fitness.

3. Under the conditions of the Harvard College training program, the majority of freshmen scoring at college average (75) or under when they entered, improved their fitness under training. Among the students whose scores classified them as good or excellent at the time of their first test, the tendency was for them to show a poorer score on their second test two or three months later.

4. This last finding indicates that the training program was adequate for the "unfit" but too easy for the already "fit," who needed harder exercise in order to maintain or improve their fitness.

5. More satisfactory results were obtained when students scoring below average were subjected to a compulsory conditioning program, and those scoring above average were free to choose their own form of compulsory athletics. Under this system, each group progressed more regularly than when all had been subjected to the same physical training program, irrespective of their fitness.

6. Each man has a maximum efficiency which he can develop progressively through regular and adequate training; but no matter how hard and assiduous the training, superior scores can only be attained by men who constitutionally possess the potential physical efficiency.

BIBLIOGRAPHY

1. Gallagher, J. R., and L. Brouha, *Yale Journal of Biology and Medicine*, 15 (1943), 657.
2. Bock, A. V., *et al. Jour. Physiology*, 46 (1928), 149.
3. Dill, D. B., and L. Brouha, *Travail Humain*, 5 (1937), 1.
4. Robinson, S., H. T. Edwards, and D. B. Dill, *Science*, 85 (1937), 409.
5. Johnson, R. E., L. Brouha, and R. C. Darling, *Rev. Can. Biologie*, 1 (1942), 491.
6. Brouha, L., A. Graybiel, and C. W. Heath, *Rev. Can. Biologie*, 2 (1943), 86.
7. Brouha, L., and C. W. Heath, *New England Med. Jour.*, 228 (1943) 473.

Studies Completed by Members of the National Association of Physical Education for College Women, 1941-1943

By Pauline Hodgson

Chairman, Committee on Research and Studies
University of California
Berkeley, California

(Submitted for publication March, 1944)

THE following list of studies has been compiled from reports made in the spring of 1943 by representatives of all institutions having membership in the National Association of Physical Education for College Women. Bibliographical data are included for those which have been published. Unpublished theses are in most cases available from the several college libraries by means of interlibrary loan. Further information regarding other unpublished studies may be obtained from the sponsoring department, either from the author or from the department library.

ACCIDENTS AND SAFETY

Small, Mildred. A critical evaluation of safety patrols in junior high school. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

ADMINISTRATION

Cobb, Louise S. (with Verne S. Landreth), "War Emergency Certification in Physical Education in the United States," *Res. Quart.* 14:4 (Dec., 1943).

Kozelka, Ceil. Equipment and war time restrictions on manufacturing. 1943. Department of Physical Education for Women, Ohio Northern University, Ada, Ohio.

Leck, Zena G. Present practices in women's athletic associations in the public junior colleges of California. 1943. M. A. Thesis. University of Southern California Library, Los Angeles, California.

VerKruzen, Marguerite Louise. The use, cost, and construction of outdoor tennis practice boards. 1941. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

ANTHROPOMETRY

Andersen, Virginia Hall. Secular trends in bodily size of Wellesley College students as shown by comparisons of mothers and daughters. 1943. M. A. Thesis. Wellesley College Library, Wellesley, Massachusetts.

Bell, Margaret Ould. "A Comparison of Five Methods Designed to Predict the 'Normal' Weight of College Women," *Res. Quart.*, 15:1 (Mar., 1944).

Benson, Rita May. The anatomical adaptations of the bones of the pelvic girdles and hind limbs of the rabbit and armadillo. 1943. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

Jennifer, Jean Betty. An evaluation based on the opinions of examining physicians of two methods of determining normal weight for college women. 1942. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

AQUATICS

Cake, Frances Elizabeth. The relative effectiveness of two types of frog kick in swimming the breast stroke. 1941. M. A. Thesis. Wellesley College Library, Wellesley, Massachusetts.

Klar, Sedwyn. An investigation of a method of training judges of diving, 1942. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

Marting, Catherine. Norms for college women in the crawl stroke and its elements. 1943. Department of Physical Education for Women, University of Wisconsin, Madison, Wisconsin.

Mason, Elizabeth. Questionnaire on swimming research for Aquatic Committee, N.S.W.A. 1943. Department of Physical Education, Monticello College, Godfrey, Illinois.

ATHLETICS

Cernick, Zora (with W. W. Tuttle), "The Determination of the Size of a Standard Discus for College Women," *Res. Quart.* 14:3 (Oct., 1943).

Colville, Frances Meaker. An analysis of the elements of the tennis serve in relation to accuracy in serving. 1943. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

Hall, Sue M. Quiz on sports. 1943. Department of Physical Education, University of Louisville, Louisville, Kentucky.

Hesslein, Jane. Lesson reliability of archery scores made with the use of an accurate aiming device. 1943. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

Jones, Edith. A study of knowledge and playing ability in basketball for high school girls. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

Knight, Caroline Lee. A motion picture as a visual aid for teaching crew. 1943. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

Mordy, Margaret. A study of officiating in women's basketball. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

ATTITUDES

Moore, Beverly Young, "The Attitude of College Women Toward Physical Activity as a Means of Recreation," *Res. Quart.* 12:4 (Dec., 1941).

CHARACTERISTICS OF PHYSICAL EDUCATION TEACHERS

Gross, Katherine Frances. A study of interests and personality traits of women students majoring in physical education. 1943. M. A. Thesis. University of California Library, Berkeley, California.

COSTUME

Gunther, Virginia Rebecca. The history of costumes worn by American girls and women for physical education and recreational sport activities. 1942. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

CURRICULUM

Cobb, Louise S. A Study of the Functions of Physical Education in Higher

Education. Teachers College, Columbuia University Press. 1943.

Glassford, Ruth Estelle. A survey of the opinions of a selected group of Newton High School graduates in regard to the extracurricular and physical education program. 1941. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

McClure, Dorothy J. A program of physical education for college women. 1943. Department of Physical Education, James Millikin University, Decatur, Illinois.

McGill, Shirley Frances. Bibliographical material for the guide to the development of the curriculum in health and physical education for the state of Washington. 1943. Department of Physical Education for Women, University of Washington, Seattle, Washington.

Wible, Mary Marjorie. Suggested influences of the early period of the war on the program of physical education for undergraduate women in selected colleges and universities. 1943. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

DANCE AND RHYTHM

Grotts, Pearl. Sociological aspects of the Crow Indian dances. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

Harris, Jane Allen. A teaching unit of rhythms for the fourth grade, with percussion and accompaniment: A series of sixteen lessons, evaluated and revised after teaching, and designed for use by the class room teacher. 1942. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

Kay, Marjorie Lew. Augmenting oriental dance movement by the adaptation of modern dance technique: An experiment in choreography to demonstrate the possibilities of blending oriental symbolic movement and movements of greater freedom based on the principles of American modern dance. 1942. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

Klar, Sedwyn. Analysis of existing tap dance terminology. 1942. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

Lewis, Madalynne Solomon. Some Mexican folk dances as found in Los Angeles, California: Music, choreographies, and photographs. 1942. M. A. Thesis. University of California Library, Los Angeles, California.

McGurk, Margaret Knapp. A study of traditional dances popularly taught in the upper elementary grades. 1941. Department of Hygiene and Physical Education, Wellesley College Library, Wellesley, Massachusetts.

Mitchell, Elizabeth Ruggles. A teaching unit of rhythms for the fourth grade, with percussion and accompaniment: A series of sixteen lessons, evaluated and revised after teaching, and designed for use by the class room teacher. 1942. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

Murray, Josephine Ketcik. A test for elementary students in appreciation of dance. 1943. M. A. Thesis. University of California Library, Los Angeles, California.

Phelps, Jeanne. The teaching of rhythmical activities in grades IV and VI. 1941. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

Politzer, Hedi. Two teaching units of creative dance for short-term summer camps for girls. 1943. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

Riegel, Ruth Ann. The historical development of American folk dancing. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

EXTRACURRICULAR

Lowrie, Kathleen. Factors which relate to the extracurricular performance of college women. 1942. Ph. D. Dissertation. State University of Iowa Library, Iowa City, Iowa.

GUIDANCE

Little, Lillian H. An analysis of certain records used in the guidance of prospective teachers of physical education. 1943. M. A. Thesis. University of California Library, Los Angeles, California.

HEALTH

Fang, Chi. The tuberculosis program for women in selected colleges and universities. 1941. Department of Hygiene and Physical Education, Wellesley College Library, Wellesley, Massachusetts.

Hoffman, Ethel Pauline. Certain physical and physiological characteristics as related to the incidence of severe dysmenorrhea. 1942. M. A. Thesis. Wellesley College Library, Wellesley, Massachusetts.

Jennifer, Jean Betty. A study of daily habits of living and of related health problems of a group of undergraduate women in a negro university. 1943. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

MOTOR LEARNING

Benton, Rachel. "The Measurement of Capacities for Learning Dance Movement Techniques." 1942. *Res. Quart.*, 15:2 (May, 1944).

Bromley, Zoe. An experiment in concentrated versus distributed learning in basketball achievement for ninth-grade girls. 1942. M. A. Thesis. University of California Library, Los Angeles, California.

Davies, Dorothy R. The effect of tuition on the acquisition of a complex motor skill. 1943. Department of Physical Education, Southern Illinois State Teachers College, Carbondale, Illinois.

Fulton, Ruth Enterline, "Speed and Accuracy in Learning a Ballistic Movement," *Res. Quart.* 13:1 (March, 1942).

Harris, Ruth Winsor. The re-education of paralytic muscles by means of individual games, sport techniques, and supervised activities. 1943. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

Kuhl, Louise. A study of the learning rate of college women in certain physical activities as related to their general motor ability. 1942. Ph. D. Dissertation. State University of Iowa Library, Iowa City, Iowa.

MOTOR SKILLS

Hoadley, Dorothy. A study of the catching ability of children in grades one to four. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

PHYSICAL FITNESS (including efficiency and endurance)

Broer, Marion. Study of physical efficiency for freshmen and sophomores, 1942-1943. 1943. Department of Physical Education, Smith College, Northampton, Massachusetts.

Matson, Elizabeth. Motor fitness of freshmen and sophomore college women. 1943. Department of Physical Education for Women, Kalamazoo College, Kalamazoo, Michigan.

PHYSIOLOGY

Smalley, Jeannette. Changes in endurance of college women in certain physical education classes. 1943. M. A. Thesis. University of California Library, Los Angeles, California.

Staff of Department of Physical Education for Women, University of Michigan. Effect of required physical education activity on scores obtained on selected tests of physical fitness. 1943. Department of Physical Education for Women, University of Michigan, Ann Arbor, Michigan.

Brown, Carrie M. A study of certain physical phenomena associated with the menstrual cycle in an unselected group of college women. 1943. M. A. Thesis. University of California Library, Berkeley, California.

Espenschade, Anna, "Physiological Maturity as a Factor in the Qualification of Boys for Physical Activity," *Res. Quart.* 15:2 (May, 1944).

Gilbert, Mary Elizabeth. A survey of certain factors in growth as illustrated by the growth of drosophila, albino rats, and children. 1943. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

McClure, Dorothy J. Exercise and its relation to diabetes mellitus. 1943. Department of Physical Education, James Millikin University, Decatur, Illinois.

Metheny, Eleanor (with L. Brouha, R. E. Johnson, and W. H. Forbes), "Some Physiologic Responses of Women and Men to Moderate and Strenuous Exercise: A Comparative Study," *American Journal of Physiology*, 137:318, 1942.

Phillips, Helen Frances. The physiologic effects on college women of immersion in water of 65° to 75° Fahrenheit: I. Temperature changes. 1941. M. A. Thesis. Wellesley College Library, Wellesley, Massachusetts.

Templin, Joyce. A study of the responses of women to water of swimming pool temperature. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

Timmins, Barbara Louise. The physiologic effects on college women of immersion in water of 65° to 75° Fahrenheit: II. Cardio-vascular and respiratory changes. 1941. M. A. Thesis. Wellesley College Library, Wellesley, Massachusetts.

Young, Olive. A study of kinesthesis in relation to selected movements. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

POSTURE, CARRIAGE, AND BODY MECHANICS

Cuddeback, Caryl. Studies in the analysis of gait. 1943. M. A. Thesis. University of California Library, Berkeley, California.

Fuller, Josephine Alida. Preliminary study of a simplified method of objectively grading posture. A comparison of the "Wellesley Objective Method" with a method employing use of plumb-lines. 1941. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

Grace, Margaret Eleanor. "An Analysis of Certain Factors in the Gait of College Women," *Res. Quart.* 14:3 (Oct., 1943).

Hazelton, Helen, and Marian Russell. A study of the body mechanics involved in activities women do on a farm. 1943. Department of Physical Education for Women, Purdue University, Lafayette, Indiana.

Judd, Mary. A study of the distribution of weight on the foot in walking with and without shoes. 1943. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

Richards, Ruth Hester. The validation of certain photographic techniques for

recording lateral posture. 1942. M. A. Thesis. Wellesley College Library, Wellesley. Massachusetts.

Thornely, Doris Mabel. A study of posture in relation to body types among college women. 1943. M. A. Thesis. University of Southern California Library, Los Angeles, California.

PSYCHOLOGY

Pulley, Dorothy. A study of scholastic adjustment of hard-of-hearing children. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

RECREATION

Bassett, Jeanne. Recreational outing activities, an integral part of liberal education. 1943. M. A. Thesis. Miami University Library, Oxford, Ohio.

Bryant, Ruth. The development of commercial recreation in Des Moines. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

Dail, Evelyn. Recreational resources for high school students in South St. Joseph, Missouri. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

Deaton, Jane. A study of the recreational activities for girls of Magnolia High School, Matewan, W. Virginia. 1943. Department of Physical Education for Women, University of West Virginia, Morgantown, West Virginia.

Fowler, Hazel. A study of juvenile delinquency and recreation in Iowa City. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

Stephenson, Kathryn. The trend of recreational interests of young women from college to adult life. 1941. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

Sweeney, Mary Caroline. A study of certain aspects of leisure-time activities for adults in Greater Boston. 1941. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Massachusetts.

STRENGTH

Olney, Sue. The relationship of girths of the limb and trunk to muscular strength in adult females. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

Smalley, Marian A. Changes in arm-and-shoulder girdle strength of college women in certain physical education classes. 1943. M. A. Thesis. University of California Library, Los Angeles, California.

Wilson, Marjorie, "A Study of Arm and Shoulder Girdle Strength of College Women in Selected Tests," *Res. Quart.*, 15:3 (1944).

SURVEYS

Keeney, Bessie. A study of health education in schools of the Central District. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

Lanan, Orisa. The status of girls' physical education in the secondary schools of Iowa. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

Scott, Gladys. The status of physical education in the elementary schools of Iowa. 1942. Department of Physical Education for Women, State University of Iowa, Iowa City, Iowa.

Shurtz, Maxine Jeanette. A study of the present program of recreation and health in selected organizations of the Y.W.C.A. 1943. Department of Hygiene and Physical Education, Wellesley College, Wellesley, Mass.

TESTS AND MEASUREMENTS

Bontz, Jean. An experiment in the construction of tests of some of the fundamental skills used by fifth- and sixth-grade children in soccer. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

Bookwalter, Carolyn. A study of the use of the modified Indiana University Motor Fitness Index as a measure of physical ability in physical education for college women and high school girls. 1943. Department of Physical Education for Women, Indiana University, Bloomington, Indiana.

Buchanan, Ruth. Achievement tests in speedball for high school girls. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

Clarke, Harriet, "A Functional Physical Fitness Test for College Women," *Journal of Health and Physical Education*, 14:7 (Sept., 1943).

Duncan, Gertrude I. The validity of health information gained through radio advertising. 1943. Department of Physical Education for Women. Temple University, Philadelphia, Pennsylvania.

Espenschade, Anna, "A Report of the Test Committee of the Western Society of Departments of Physical Education for Women in Colleges and Universities," *Res. Quart.*, 14:4 (Dec., 1943).

French, Esther, "Construction of Knowledge Tests in Selected Professional Courses in Physical Education," *Res. Quart.*, 14:4 (Dec., 1943).

Kelley, Phyllis Irene. The reliability of certain motor tests as administered to college women under routine testing conditions. 1942. M. A. Thesis. Wellesley College Library, Wellesley, Massachusetts.

N.S.W.A. Research Committee, Eleanor Metheny, Chairman, "Physical Performance Levels for High School Girls," *Journal of Health and Physical Education*, 14:8 (Oct., 1943).

Phillips, Marjorie. A comparison between different tests of tennis ability. 1943. Department of Physical Education for Women, Indiana University, Bloomington, Indiana.

Phillips, Marjorie. The standardization of a badminton knowledge test for college women. 1943. Department of Physical Education for Women, Indiana University, Bloomington, Indiana.

Phillips, Marjorie, Eloise Ridder, and Helen Yeakel. "Further Data on the Pulse-ratio Test for College Women," *Res. Quart.*, 14:4 (Dec., 1943).

Scoville, Mary May, and Marian Russell. Revision of Purdue Health Knowledge Test. 1943. Department of Physical Education for Women, Purdue University, Lafayette, Indiana.

Simons, Lois Anne. An analysis of two tests of motor ability in terms of skill scores earned by college women. 1941. M. A. Thesis. Wellesley College Library, Wellesley, Massachusetts.

Staff of Department of Physical Education for Women, Purdue University, Constance Baum, Chairman. A study of physical fitness tests for college freshmen women. 1943. Department of Physical Education for Women, Purdue University, Lafayette, Indiana.

Underkofler, Audry. A study of skill tests for evaluating the ability of junior high school girls in softball. 1942. M. A. Thesis. State University of Iowa Library, Iowa City, Iowa.

A Study of The Reaction Time of Physically Trained Men

By Lloyd R. Burley

Southwestern Louisiana Institute
Lafayette, Louisiana

(Submitted for publication, April, 1944)

THERE has been considerable study of the physical and psychological characteristics of individuals who have demonstrated unusual ability in physical activities. Attempts have been made to determine what differences characterize trained and untrained men. Less attention has been given to differences between groups of men excelling in different sports. The factors affecting reaction time have received considerable study but the relationship between reaction time and achievement in physical activity has been given comparatively little attention. This study of the reaction time of physically trained men has been approached with the following questions in mind: Do the reaction times of athletes differ from those of non-athletes? Do the reaction times of athletes in one sport differ from the reaction times of athletes in other sports? If so, in what respects do they differ?

REVIEW OF LITERATURE

Many studies of reaction time have been reported. Most of these are concerned with the effect of various factors upon reaction time. Five studies were found which dealt with the relationship of reaction time and achievement in physical activity.

Westerlund and Tuttle [10] * studied the reaction times of twenty-two university track men as indicated by a finger response to a light stimulus. They report a high degree of relationship between speed of reaction time and speed in running the seventy-five yard dash. The mean reaction time of three champions (one 220-yard low hurdler and two 220-yard dash men) was "definitely shorter" than the mean of the reaction time scores of seven distance men, of eight middle-distance men, or of four short-distance runners.

Berse and Peasley [1] studied the reaction times of seventy-five university women. They were presented with a light stimulus and tested for three responses; removing the foot from a plate, pushing down upon a plate with the hand, and removing the hand from a plate. They found that a skilled group of eleven archers, twelve

* Superior figures refer to bibliography at end of article.

golfers, and twenty-four tennis players had faster and more stable reaction time readings than an unskilled group definitely below the average in physical performance although the difference in arm response was slight. Of the three sport groups archers were slowest, golfers next slowest, and tennis players fastest in reaction time. In both skilled and unskilled groups arm reaction was faster than leg reaction but individuals with fast arm reaction did not always have fast leg reaction time. Six who scored high in the Brace Motor Ability Test were not significantly faster than six who scored low in that test. Over a period of fourteen weeks eight beginners were trained in tennis, golf, or archery classes without significantly affecting their reaction time scores.

Miles [7] studied the reaction times of eighty-seven football men who responded to a verbal stimulus with a whole body charging movement. He found backs fastest, ends next fastest, followed by guards, tackles, and centers in the order named. Eleven starting players averaged faster than the whole group in reaction time.

Burpee and Stroll [2] measured the reaction times of forty-six men residents of a club offering gymnasium privileges. The men were subjectively divided into four groups upon the basis of regularity of participation and successful performance in physical education activities. A hand movement and a whole body movement were made in response to light stimuli. They found a significant negative relationship between success in physical education activities and hand movement and a larger negative relationship between such success and whole body reaction time.

Keller [4] measured the reaction times of three hundred fifty-nine athletes and two hundred seventy-five non-athletes from two high schools and a university. Whole body movements were made in response to light stimuli. Athletes responded faster than non-athletes. He reports that baseball, basketball, football, and track athletes comprised a group significantly faster in reaction time than the group including gymnasts, swimmers, and wrestlers but that no significant difference was found between the sports within these two groups.

APPARATUS

The apparatus used in the present study was made up of a stimulating, a response, and a recording unit as diagramed by Lapp.[5] In the stimulating unit was a bank of 3.2 V-Ray lights which was placed on a table before the subject. The first lamp furnished the stimulus for the simple reaction time test. The pattern of lights four-two-three-one, flashed in the order named, composed the complex stimulus. The first lamp was operated by a throw switch; hence the intensity of its light did not vary. The response circuit

was closed by pressure upon a key. A Dunlap Chronoscope recorded the reaction time in thousandths of a second.

COLLECTING THE DATA

Preliminary Study.—A preliminary study was made to determine the number of readings necessary to give a stable mean. A standard error of five thousandths of a second was obtained for one-hundred readings for the subjects measured. It was decided that this would give a sufficiently stable mean and would facilitate computation.

Inspection of the scores of the preliminary study indicated that if twenty-five practice trials were allowed, there was no consistent improvement in subsequent series of twenty-five readings each.

During the preliminary study a definite method of administering the tests was developed.

Administration of the Test.—The subject was placed in a dark room with his index finger on the response key. On a desk before him was the bank of lights used as the stimulus unit. The chronoscope was placed in an adjoining room, the door of which was closed during the experiment. As an additional precaution against the subject hearing the chronoscope start and stop, a water tap was allowed to run. The running water also aided in minimizing the effect of extraneous noises.

In the simple reaction-time test the subject was told that before each flash the operator would say, "Ready," thus giving him warning that the light would appear. The interval between the warning and the flash was varied so that the subject could not form the habit of responding to the vocal stimulus. This time interval was kept between one and four seconds. This is the length of warning period which best utilizes the state of readiness to respond, according to Ruch.[9] The subject responded to the flash of the light by pressing the response key with his index finger. Twenty-five practice trials preceded the simple reaction-time test. In all but two cases one hundred or more readings were taken of the simple reaction time. These were taken in series of twenty-five readings. After each series the subject was asked to stretch and walk about. Each reading was recorded on a prepared sheet.

In the complex test there was no verbal signal preceding the stimulus pattern. The lights were flashed in indiscriminate order preceding the pattern. The subject was taught to respond to number one light when preceded by lights four, two, three in the order named. The time interval between lights was varied but kept between one and four seconds. Twenty-five practice trials were given before the first series of twenty-five readings was taken in the complex test.

In most instances all of the readings were taken during one visit to the laboratory. About one and one-half hours were required to test one subject.

Subjects.—The data were collected from seventy-seven male subjects in attendance at the State University of Iowa. These men were from eighteen to thirty-one years of age. None had apparent physical defects. The subjects were divided into seven groups which will be designated as: (1) non-letter winners, (2) high school letter winners, (3) football linemen, (4) football backs, (5) basketball men, (6) baseball men, and (7) swimmers.

The group of twenty-one designated as non-letter winners had not participated in varsity athletics in high school or college. The group designated as high school letter winners was comprised of nine men who did not participate in college varsity athletics but who had won one or more high school letters. The football linemen included sixteen winners of college athletic awards. Of these, three were centers, six were ends, four were guards, and three were tackles. The other four groups included respectively, ten football backs, nine basketball men, nine baseball men, and seven swimmers, all of whom had won college athletic awards in their respective sports. The sport groups included from forty to eighty per cent of the letter winners in those sports for the year. No formal technique for random sampling of the men was employed but no cause for systematic bias was known.

Five of the subjects had won college athletic awards in two sports. Of these, four were baseball players, two of whom had won basketball awards and two, football awards. The other was a football lineman who had also won a basketball award. The data collected from these five men are included in the data of both of the sports groups to which they belonged and may tend to minimize the differences between groups.

ANALYSIS OF THE DATA

The means and standard deviations of the simple and complex reaction-time readings were computed for each subject.

The means and standard deviations of the subjects were arranged under the seven group headings and the means of the scores and of the standard deviation were computed for each group. These group data for simple and complex tests are given in Table I.

The differences between the simple reaction-time means of the groups were analyzed. The analysis of variance technique was used to test the hypothesis that the seven groups were from the same population. This was done by comparing two independent estimates of the variance of the population.

The first estimate was based on the group means and computed by the formula:

$$\frac{n \Sigma (M - Mp)^2}{r - 1}$$

Here n represents the number in the group, M is the general mean, Mp the mean of any group, and r the number of groups. The second estimate was based on the variance within groups and computed by the formula:

$$\frac{\Sigma d^2}{r\ (n - 1)}$$

Here d represents the deviation of any measure within the group from the mean of the group, r represents the number of groups, and n is the number in the group. The ratio of the "between groups" and "within groups" variances was computed. Snedecor's Table for F [6] was entered to determine whether or not the ratio was significant at the five per cent level. At this level of significance an F of 2.22 is necessary to conclude that our hypothesis (that the seven groups of reaction-time means studied were drawn from the same population) is false. An F of 2.22 indicates that a real difference rather than a chance difference in reaction time exists among these groups.

The application of the F test may indicate that statistically significant differences exist among these groups but does not indicate where these differences lie. Where a significant F was obtained a t test was applied to determine the significance of the differences between group means.

The t was computed by the formula:

$$\frac{Mx - My}{\text{estd } Mx - My}$$

Mx and My represent the means of any two groups. Fisher's Table for t [6] was entered at the five per cent level. A t of 1.96 was necessary to be significant.

In the same manner the differences between groups were studied in relation to complex reaction-time scores, the mean standard deviations of the simple reaction-time scores, and the mean standard deviations of the complex reaction-time scores.

The relative differences in simple and complex means and standard deviations were studied. The mean of the simple reaction time scores was found. The mean of the complex reaction-time scores was found. The per cent of increase of the complex over the simple reaction-time means was computed. Similarly the per cent of increase of the complex mean standard deviations over the

simple mean standard deviation was computed. A comparison was made between the rates of increase in these two measures.

FINDINGS

In Table I it may be observed that considerable differences exist among the groups. Men who have won college athletic awards in baseball have the fastest reaction time, ranking in first place in both simple and complex tests. They also have the lowest mean standard deviation in the complex test indicating least variability. Their score is excelled once by the football linemen, who show a lower mean standard deviation in the simple reaction-time test.

No group maintains the same position throughout the ranking of all four measures.

TABLE I

MEANS AND MEAN STANDARD DEVIATIONS OF THE SCORES MADE BY SEVEN GROUPS OF UNIVERSITY MEN IN SIMPLE AND COMPLEX REACTION TIME TESTS

	Number Subjects	*Simple Reaction Time Millisecs.*		*Complex Reaction Time Millisecs.*	
		Mean	*M.S.D.*	*Mean*	*M.S.D.*
Baseball, varsity	9	250.0	26.0	302.8	37.3
Basketball, varsity	9	257.0	26.8	317.6	42.9
High School Letter Winners	9	263.3	29.2	330.4	53.5
Football Backs, varsity	10	267.5	24.1	305.2	39.0
Football Linemen, varsity	16	267.8	23.8	313.4	41.3
Non-letter Winners	21	282.9	30.5	333.6	52.9
Swimmers, varsity	7	291.3	28.7	339.4	50.7

At the five per cent level of confidence the F test showed that significant differences in reaction-time scores existed among the seven groups of athletic and non-athletic university men.

The application of the t test showed that in simple reaction time the baseball players were significantly faster than the football linemen, football backs,* swimmers, and non-letter winners. Basketball men, football backs, football linemen, and high school letter winners were significantly faster than swimmers and non-letter winners. The differences between the means of the other groups were not significant in this test.

Likewise in the complex reaction-time test baseball men and football backs were significantly faster than high school letter winners, swimmers, and non-letter winners. Football linemen were significantly faster than swimmers and non-letter winners. Other group differences in mean complex reaction times were not significant.

* This precedence of baseball players over football men agrees with the findings of Keller as reported in Table IV, p. 153, reference No. 4.

Group differences in variability may be noted in Table I. In the simple reaction-time test the football backs and football linemen had mean standard deviations significantly smaller than high school letter winners and non-letter winners. The baseball men had a smaller mean standard deviation than non-letter winners. The differences in mean standard deviations existing between the other groups were not significant.

In the complex reaction-time test baseball men, football backs, and football linemen, have significantly smaller mean standard deviations than high school letter winners, swimmers, and non-letter winners. Basketball men have a smaller mean standard deviation than the high school letter winners and non-letter winners. Other differences in mean standard deviations in the complex reaction-time test were not significant at the five per cent level of confidence.

The general mean of the complex reaction-time scores shows an increase over the general mean of the simple reaction-time scores of twenty per cent, while the general mean of the complex reaction-time standard deviations shows an increase over the general mean of the simple reaction-time mean standard deviations of sixty-nine per cent. The variability increases approximately three and one-half times as fast as does the reaction time.

CONCLUSIONS

1. All individuals reacted more slowly to complex stimuli than to a simple stimulus.

2. The reactions of all individuals to the complex stimuli were more variable than their reactions to the simple stimulus.

3. For the group as a whole the rate of increase of the complex mean standard deviation over the simple mean standard deviation was three and one-half times the rate of increase of the complex mean over the simple mean.

4. Significant differences in speed and variability of reaction time existed among football linemen, football backs, basketball men, baseball men, swimmers, high school letter winners, and non-letter winners.

5. Significant differences in mean reaction time of different athletic and non-athletic groups are not always accompanied by equally significant differences in variability.

6. The winners of college athletic awards in baseball and basketball were not significantly excelled by any group in speed of reaction time nor had any group a smaller mean variability.

7. In speed or variability of reaction time the football backs were excelled but once, football linemen twice, high school letter winners eight times, swimmers eleven times, and non-letter winners

fifteen times out of the possible twenty-four instances in which they could have been excelled had they always been significantly surpassed by all groups.

BIBLIOGRAPHY

1. Berse, Dorothy, and Virginia Peaseley, "Relation of Reaction Time, Speed, and Agility of Big-Muscle Groups to Certain Sports Skills," *Research Quarterly*, 8:1 (March, 1937), pp. 133-142.
2. Burpee, R. H., and Wellington Stroll, "Measuring The Reaction Time of Athletes," *Research Quarterly*, 7:1 (March, 1936), pp. 110-118.
3. Griffith, Coleman R. *Psychology and Athletics.* New York: Charles Scribner's Sons, 1928. Pp. 153-170.
4. Keller, Louis B., "The Relation of Quickness of Bodily Movement to Success in Athletics," *Research Quarterly*, 13:2 (May, 1942), pp. 146-155.
5. Lapp, V. W., "An Analysis of Movement on the Basis of Latent Times and Variabilities," *University of Iowa Studies in Physical Education No. 2*, 6:3 (October, 1935), p. 27.
6. Lindquist, E. F. *Statistical Analysis in Educational Research.* Chicago, Ill.: Houghton Mifflin, 1940.
7. Miles, W. R., "Studies in Exertion: Individual and Group Reaction Time in Football Charging," *Research Quarterly*, 2:3 (October, 1931), pp. 5-13.
8. Nakamura, H., "An Experimental Study of Reaction Time of the Start in Running a Race," *Research Quarterly*, 5:1, Supp. (March, 1934), pp. 33-44.
9. Ruch, Floyd L. *Psychology and Life.* Chicago, Ill.: Scott, Foresman. Pp. 464-470.
10. Westerlund, J. H., and W. W. Tuttle, "Relationship Between Running Events in Track and Reaction Time," *Research Quarterly*, 2:3 (October, 1931), pp. 95-100.

What Is A Physical Fitness Program For Boys?

By KARL W. BOOKWALTER

Indiana University
Bloomington, Indiana

(Submitted for publication, November, 1943)

EDITORIALS, letters from teachers in the field, interest evidenced at conventions, and the lack of agreement in articles, lectures, and discussions all point to the need for information concerning appropriate activities and procedures for the conduct of physical fitness programs for boys in high schools and colleges.

Recent research, preliminary to the formulation of a physical fitness program, revealed much confusion or lack of agreement in actual practices in this new emphasis. However, synthesis of the data drawn out from the analysis of fifteen authoritative sources indicated certain trends and emphases which were most helpful. This article aims to make available to others, confronted with the administration of physical fitness programs for boys, the guidance from this study. Coming from the publications of our armed forces, governmental departments, or nationally prominent authors, the facts should be somewhat authentic, with proper treatment.

The purposes, activities, and measurements as presented in these program sources are tabulated, organized, and interpreted in the following paragraphs. It is proposed, later, to continue the study by the analysis of policies, procedures, and methodologies, thus giving a rather complete picture of the problem.

Throughout this report the marked lack of source agreement will be obvious. Withal, there can be shown to be emphases and relationships which are most helpful when the bare facts are interpreted. A study of this kind does not lend itself to objective statistical interpretation but a rather varied and lengthy curricular experience has enabled the author to be more or less orderly in his analysis and conclusions.

THE OBJECTIVES FOR PHYSICAL FITNESS

In practically every source examined the list of objectives was such that the list was unique with but slight exception. A total of 66 objectives was revealed. Of these only 8 were mentioned from 3 to 6 times. (No objective was mentioned more than 6 times in the 15 sources.) The length of the lists of objectives in each source ranged from 0 (three sources made no direct statement of objectives) to

16 objectives, found in one source. On the average there were approximately 7 objectives listed in each source.

The eight most frequently mentioned objectives in order are: strength (6), endurance (6), health (4), skill (4), speed (4), agility (4), physical growth and organic vigor (3), and bodily coordination and control (3). Such frequencies provide little assurance of the validity of the findings. By grouping the 66 objectives under 6 generalized aims and by indicating the *item* and *mention* frequencies, a rather informative picture of the contemporary philosophy concerning physical fitness programs is obtained. The following tabulation indicates these facts. Where the grouping may seem somewhat inconsistent, in places, this may be largely attributable to the relationships which prevailed in the source or sources involved. The left column of figures indicates the number of objectives mentioned which might be included under the general objective. The middle column indicates the total frequency by which the objectives collectively were mentioned in all sources. The right column indicates the assurance with which the items may be accepted as typical.

General Objectives in Rank Order	*Items*	*Frequencies*	*Assurance*
Physical growth and organic vigor: health, power, freedom from disease and defect, strength, muscular endurance, activity, stamina, condition, ability to withstand hardships, physical fitness, cardiovascular endurance.	14	32	2.3
Motor skills: speed, agility, neuromuscular development, control, motor fitness, coordination, flexibility, skills with equipment, ability to overcome physical obstacles, timing, ability to swim, posture, explosive power, balance, skill in a variety of activities.	17	32	1.9
Psychological and interpretive powers: will, freedom from worry, fear, or tension, alertness, venturesome spirit, emotional impulsive development, desire to keep fit, morale, health knowledge, decisiveness, anticipation, confidence, courage, self-discipline, self-confidence, appreciation of nature and significance of fitness, relaxation, knowledge in variety of activities.	17	22	1.3
Social traits and qualities: self-reliance, smartness, competitive spirit, leadership, initiative, pride, discipline, resourcefulness, self-respect, poise, teamwork, fighting spirit.	14	17	1.2
Safety capacity: lifesaving skills, self-defense skills, first-aid skills.	3	5	1.7
Recreational capacity: worthy use of leisure.	2	3	1.5

The above primary grouping, it can be seen, is but a slight modification of a nationally accepted list of objectives of physical

education. The high ranking of the psychological objective on a practically equal level with the physical and motor skill objectives bears out the philosophical recognition of the organismic unity of the individual. Even in these days of emphasis upon physical fitness it is obvious that these desired outcomes cannot be disassociated from the intellectual learnings. It is apparent that even the most zealous workers for strength, endurance, speed, velocity, and motor ability will perforce have to attend to the concomitant changes in intellectual and emotional behavior.

By reason of the nature of the activities, policies, procedures, and methodologies accompanying these objectives the author is convinced that more emphasis is being placed upon the safety objectives than is indicated in the above list; witness the emphases upon swimming and lifesaving, upon tumbling for training in bodily control, upon spotting and inspection of facilities, and upon the health examination preceding vigorous activity programs. There is a recognizable and lamentable neglect of recreational activities in the training of the armed forces and pre-inductees, however. This is especially undesirable if one can reasonably expect the vast majority of our military men to return to normal life after the emergency.

TYPES OF ACTIVITY RECOMMENDED FOR PHYSICAL FITNESS

There is a marked variability in the types of activities recommended for physical fitness. Considering the facts that classes or types of physical education are broad categories and that physical education has been in existence since ancient Greek days this is a bit deplorable.

One hundred and three activities are mentioned in 15 sources. Only 17 types are mentioned 5 to 13 times. There is a range of from 5 to 21 types in the several sources, an average of 16 plus types per source. However. there is not the uniqueness to each source in this regard as was true with regard to the statements of objectives in the same sources.

The 17 types of activities discussed above and which are mentioned 5 or more times in rank order: physical tests and measurements (13), calisthenics and conditioning drills (12), tumbling (11), obstacle courses (11), team sports (10), swimming (10), apparatus (10), walking and running (7), combative contests (7), medical examination (7), relays (7), marching (6), boxing (6), rope skipping (6), group games (6), wrestling (5), and military track and field (5).

A reorganization of the 103 types of activities under 11 more general titles revealed a definite emphasis and gave more assurance of the reliability of the recommendations than was possible before.

The following rank list is quite informative as to variety and emphasis:

Activity Type	*Items*	*Frequency*	*Assurance*
Conditioning exercises	26	69	2.7
Athletic sports	23	50	2.1
Combatives	14	30	2.1
Aquatics	8	26	3.25
Tests and measurements	7	23	3.2
Stunts, tumbling, and pyramids	3	21	7.0
Outing	11	22	2.0
Apparatus	1	9	9.0
Hygienic and administrative	3	10	3.3
Marching	1	6	6.0
Rhythmics	2	3	1.5

With the exception of outing, marching, and rhythmic activities, it is quite apparent that each of the above classes of acitivity should be represented in a contemporary physical fitness program. Reference to the 17 types of activities with highest frequencies will give indication as to "must" activities within the program. A classification of specific activity types under the above general areas follows. The frequencies of mention accompany the specific types as well as the general areas under which they are grouped. The government authorities have repeatedly stated that marching is a non-essential activity as far as school physical fitness programs are concerned.

Activities	*Items*	*Frequency*	*Assurance*
Aquatics 3	8	26	3.25
swimming 10			
lifesaving 4			
water safety 2			
wartime swimming 2			
diving 2			
boating and canoeing 2			
aquatic testing 1			
Combatives 4	14	30	2.1
boxing 6			
wrestling 5			
dual combatives 4			
hand-to-hand fighting or combat 2			
judo 2			
combat fencing 1			
fencing 1			
jui jitsu 1			
savate and wartime boxing 1			
self-defense 1			
unarmed defense and disarming 1			
wartime wrestling 1			
Athletic sports 4	23	50	2.1
Team sports 10	5	10	2.0
basketball 3			
soccer 3			
touch football 2			
ice hockey 1			
speedball 1			

Activities	*Items*	*Frequency*	*Assurance*
Recreational sports 1 *	12	12	1.0
archery 1			
badminton 1			
baseball 1			
bowling 1			
golf 1			
handball 1			
horseshoes 1			
softball 1			
table tennis 1			
tennis 1			
volleyball 1			
Group games and relays 1	3	15	5.0
relays 7			
group games 6			
rough and tumble games 1			
Gymnastic activities 3	30	106	3.5
Conditioning exercises:	25	69	2.8
obstacle courses 11			
walking and running 7			
rope activities 6			
jumping 3			
posture 3			
transportation methods 3			
climbing 2			
grass exercise 2			
ranger exercises 2			
remedial 2			
rifle exercises 2			
weight lifting 2			
alertness drills 1			
calisthenics 1			
crawling 1			
cross country 1			
exercises with apparatus 1			
mass exercises 1			
medicineball 1			
physical exercise 1			
rope climbing 1			
steeple chase 1			
trench exercises 1			
vaulting 1			
wall scaling and tree climbing 1			
Apparatus	1	10	10.0
Stunts, tumbling, and pyramids	3	21	7.0
tumbling 11			
single and dual stunts 8			
pyramids 2			
Marching	1	6	6.0
Outing 2	11	22	2.0
hiking 4			
camping 3			
cycling 3			
horseback riding 3			
picnicking 2			
fishing 1			
mountaineering 1			
skating 1			
skiing 1			

* Due to one source only

Rhythmic 1 dancing 2	2	3	1.5
Tests and measurements physical tests and measures 13 military track and field 5 agility tests 1 individual athletic events 1 self-testing 1 throwing 1 track and field 1	7	23	3.2
Hygienic and administrative health examination 7 administrative 2 hygienic 1	3	10	3.3

ELEMENTS UTILIZED IN MEASURING AND TESTING PHYSICAL FITNESS

A further indication of the real objectives of the physical fitness programs is found in the study of the items and elements employed in measuring physical fitness results. A wholesome tendency of measuring for certain stated objectives is revealed. The measurements are almost entirely of the physical development and motor skills areas, however. This indicates that practice and theory part whenever the intellectual and social objectives are concerned.

It is revealed that there are 73 items employed in the tests and measurements phase of the physical fitness program. There is a range of from 0 to 32 in all sources (two sources made no mention of items for measurement of physical fitness). On the average 12 items were listed in each source (a median of 11 items). The 13 items of highest frequency of mention in order are: chinning (10), push-ups (8), 100-yard run (8), running high jump (8), running broad jump (7), squat thrust (Burpee test) (7), sit-ups (7), standing broad jump (7), 440-yard run (6), vertical jump (6), 880-yard run (6), the rope climb (6), and the mile run (5).

A previous analysis of the many published factor analysis studies in physical education revealed the most common factors associated with successful performance in physical education activities. The items shown to be in use by the present study of physical fitness programs can be functionally classified under those factors for the most part. Such grouping indicates that 12 items were used a total of 44 times for measuring strength, the first ranking factor in this study. Endurance, the second ranking factor, was measured by 16 items a total of 33 times. The third factor, velocity, was measured by 7 items a total of 32 times. Agility, the fourth factor, was measured by 10 items employed a total of 22 times. Motor ability had fifth place, being measured by 12 items a total of 19 times. Speed had fifth place with 6 items employed 14 times in all.

The remaining factors and items do not rate the same assurance as do the ones mentioned above. Velocity items rate the greatest assurance with an average use (mention) of over 4 times

for each item. Strength items were employed nearly 4 times each on the average. The kicking and cardiovascular fitness factors were measured least frequently and their individual items were only mentioned once each.

This analysis reveals again the complete neglect of intellectual or psychological factors in the measurements programs. This might be expected by reason of the difficulty of assaying such factors but this fact is extremely unfortunate for the programs and for the youths involved.

Test Items in Rank Order	*Items*	*Frequency*	*Assurance*
Strength: abdominal, sit-ups, arm, chin, dips, push-ups, rope climb, extension press-up, fire-arm's carry, leg lift, half lever, L.D.S.T., neck bridge, straddle chins.	12	44	3.7
Endurance: drop-off, 880 yds., 50-yd. pick-a-back, 440 yds., 5-mile hike, 1-hr. bicycle, leg-lift and sit-up, 1-mile run, 100-yd. pick-a-back, ½-mile swim, scout mile, 620-yd. obstacle, 2-mile walk, 300 yds., squat jumps, 330 yds.	16	33	2.1
Velocity: high broad jump, running high jump, running broad jump, standing backward jump, standing broad jump, three jumps, vertical jump.	7	32	4.6
Agility: base running, Burpee, bar vault, 50-yd. dodge race, 70-yd. agility run, pole vault, running dive, potato race, running hop-step-jump, standing hop-step-jump.	10	22	2.2
Motor ability: bank twist, Brace Test, forward bend, frog stand, General Motor Capacity, General Motor Quotient, hand stand, human wicket, Motor Fitness Index, swimming test, Test of a Man, trunk flexion.	12	19	1.6
Speed: 6-sec. dash, 50 yds., 60 yds., 100 yds., 220 yds., 120-yd. low hurdles.	6	14	2.3
Throwing: baseball throw, basketball throw, football pass, 12-lb. shot, 320-yd. grenade.	5	9	1.8
Cardiovascular fitness: Crampton Blood Ptosis Test, Pulse-Ratio Test, stair-steps run.	3	3	1.0
Kicking: Football punt, football goal kicking.	2	2	1.0

SUMMARY AND CONCLUSIONS

Objectives of physical growth and organic vigor are of prime importance. Motor skills rank next in value in contemporary physical fitness programs.

Psychological development is philosophically given high rank. In practice little or no thought is given to the inculcation or assessment of such outcomes.

Some emphasis is given to safety training but recreational ends are given negligible mention.

Conditioning drills and exercises are the class of activities receiving greatest emphasis. This is in accord with the stated purposes. Other high areas in order are: athletic sports, combatives, aquatics, tests and measurements, stunts, tumbling and pyramids, and apparatus work. These too are valid in the light of essential stated objectives.

There is an obvious and serious neglect of recreational experiences in the present-day programs. This is unnecessary.

No rhythmic training of a cultural nature is presented in these sources.

It might be stated parenthetically that boxing as generally presented is contraindicated for school use by our professional leaders and that judo activities have also met with disapproval for school programs. (Marching is not favored by military authorities for physical fitness programs.)

There is a commendable tendency to measure results from physical fitness programs.

These measurements are pointed at acceptable physical and organic results. They neglect, as would be expected from the proposed activities, certain highly essential psychological developments.

Strength, endurance, velocity, agility, and motor ability are the qualities most frequently measured.

These qualities are in accord with the stated objectives with the exception that no measures are proposed for psychological development.

In general there is a marked variability in objectives (66), activities (103), and measures (73) in the sources studied.

The appended list of physical fitness references is for the most part quite helpful to one confronted with the conduct of these programs.

SELECTED BIBLIOGRAPHY

Vernier, Elmon L. *Physical Training for Airmen.* Air Training Corps of America, Inc. New York, 1942.

Crampton, C. Ward. *Start Today, Your Guide to Physical Fitness.* New York: A. S. Barnes and Company, 1941.

D'Eliscu, Francois. *How to Prepare for Military Fitness.* New York: W. W. Norton, Inc., 1943.

Federal Security Agency, U. S. Office of Education. *Handbook on Physical Fitness for Students in Colleges and Universities.* Jackson R. Sharman, Chairman. Washington, D. C.: U. S. Government Printing Office, 1942.

..... *Physical Fitness Through Physical Education For The Victory Corps.* Jackson R. Sharman, Chairman. Washington, D. C.: U. S. Government Printing Office, 1942.

Indiana University, Department of Physical Education for Men. *Teaching Physical Fitness, A Manual for the Instructor of the Service Program.* Ben W. Miller, Chairman. Bloomington, Ind.: Indiana University Bookstore.

LaPorte, William Ralph, (The College Physical Education Association). *The Physical Education Curriculum.* Los Angeles, Calif.: University of Southern California Press, 1942.

Miller, Ben W., Karl W. Bookwalter, and George E. Schlafer. *Physical Fitness for Boys.* New York: A. S. Barnes and Company, 1943.

State of Indiana, Department of Public Instruction. *Physical Education, A Tentative Course of Study for Junior and Senior High Schools, Bulletin No. 126.* Frank Stafford, Chairman. Indianapolis: State of Indiana Department of Public Instruction, 1940.

....., *Tentative Physical Fitness Manual for High School Boys, Bulletin No. 136.* Frank Stafford, Chairman. Indianapolis: State of Indiana, Department of Public Instruction, 1942.

Steinhaus, Arthur H, *et al. How To Keep Fit and Like It.* Chicago: George Williams College, 1943.

United States Naval Academy. *Drill Manual.* Annapolis, 1942.

United States Navy, Bureau of Aeronautics. *Physical Fitness Program for High Schools and Colleges.* Washington, D. C.: U. S. Navy Training Division, Bureau of Aeronautics, 1942.

....., Bureau of Personnel. *Physical Fitness Manual for the U. S. Navy.* Washington, D. C.: U. S. Navy Training Division, 1943.

War Department. *Basic Field Manual, FM 21-20, Physical Training.* Superintendent, U. S. Military Academy, Chairman. Washington, D. C.: U. S. Government Printing Office, 1941.

....., *Manual of Physical Training United States Army.* Washington, D. C.: U. S. Government Printing Office, 1914.

A Comparative Study of Three Types of Chinning Tests

By R. T. DeWitt

Louisana State University

Baton Rouge, Louisiana

(Submitted for publication, October, 1943)

INTRODUCTION

CHINS, or pull-ups, as they are sometimes called, have been and probably always will be used as one of the means to develop arm and shoulder-girdle strength and endurance. In testing for the number of chins a person can do there has been some difference of opinion as to the most advantageous hand position on the bar and whether kicking and kipping are advantageous in adding to the total number of chins performed. Students for the most part prefer that the palms, when grasping the bar, be turned toward them though some prefer the palms-out method. The Army specifies that chinning be done using the latter method since most climbing under the actual combat conditions is done in that manner.

Because of these differences in opinion a study was made of various types of chinning tests in an attempt to come to some definite conclusion regarding the most efficient hand position in point of total number of chins performed and how advantageous kipping and kicking may be.

THE PURPOSE OF THE STUDY

It was the purpose of this study to determine and compare the average number of chins a group of men could do grasping the bar with palms in, the number they could do with the palms out, and the number they could do by grasping the bar any way they chose and by kipping and kicking in an effort to improve their score.

EXPERIMENTAL PROCEDURE

The men did the palms-in method on Monday, the palms-out method on Wednesday, and the kip-kick type on Friday. It was reasoned that two days was sufficient time to completely recover from chinning particularly since the men had been practicing the activity for many weeks, and were in good condition.

It is to be noted that 144 men took the palms-in and palms-out tests given on Monday and Wednesday, yet on Friday only 73 of the 144 were present to take the kip-kick type test. Rather

than use only the 73 cases for the comparison the results were divided in two parts, the first of which compares the palms-in and palms-out tests when 144 men were used and the other which had 73 cases to compare all three tests.

Irrespective of which method was used the men had to start from a straight arm-hang and return to the same position after each chin. If the arm was bent even slightly at the down position, the next chin was not counted in the total. In the up position the chin had to be as high as or higher than the bar which the subject was grasping. Each man had to be clear of the ground at all times during his test.

RESULTS

It is recorded in Table I that the mean number of the chins performed in the palms-in manner is greater than the mean of the chins performed the palms-out way by 2.08 chins. The critical ratio of this difference is 8 which indicates that there would be an excellent chance to get the same difference if the tests were run again.

TABLE I

MEAN SCORES ACHIEVED BY USE OF PALMS-IN AND PALMS-OUT METHOD OF GRASPING THE BAR IN CHINNING

Chinning Method	*Mean*	*Difference Between Means*	*Critical Ratio*
1. Palms-in	9.71	2.08	8
2. Palms-out	7.63		

In Table II it is shown that 118 men out of 144 did more chins the palms-in method than when the chins were performed with palms out; only 18 performed the same, and 8 did fewer using the first method.

TABLE II

NUMBER OF MEN WHOSE CHINNING SCORE MADE WITH PALMS-OUT GRASP IMPROVED, REMAINED THE SAME, OR DECLINED WHEN PALMS-IN METHOD OF GRASPING THE BAR WAS EMPLOYED

Number Cases	*Men Doing More Chins*	*Men Doing Same Number of Chins*	*Men Doing Less Chins*
144	118	18	8

Persons familiar with the mechanical advantage gained by the kip may be somewhat surprised at the slight difference shown in Table III between the mean of the kip-kick chinning method and

TABLE III

MEAN SCORES ACHIEVED WHEN PALMS-OUT, PALMS-IN, AND OPTIONAL GRIP KIP-KICK FORM WERE USED

Number of Cases	*Chinning Method*	*Mean*	*Difference Between Means*	
73	1. Palms-in	9.67	Methods 1 and 2	1.75
73	2. Palms-out	7.94	Methods 1 and 3	.68
73	3. Kip-Kick	10.37	Methods 2 and 3	2.43

the means of the other two. However, when it is understood that the men had never had an opportunity to learn the skill involved in the kip as performed with chins, then the slight increase in the mean appears to be more significant.

TABLE IV

TABULATION OF THE NUMBER OF MEN DOING MORE, THE SAME, OR FEWER CHINS UPON COMPARISON OF THE THREE TESTS

	More	*Same*	*Less*
Number of Men Doing More, the Same, or Less Chins with Palms-in Than with Palms-out	57	11	5
Number of Men Doing More, the Same, or Less Chins with Palms-in Than with Kip-Kick	11	22	40
Number of Men Doing More, the Same, or Less Chins with Palms-out Than with Kip-kick	4	6	63

CONCLUSIONS

1. The results of this study show that on the average, a man can do approximately two more chins with the palms-in than with the palms-out grip.

2. The kip-kick method of chinning will produce slightly more chins than the palms-in method. Since chinning tests indicate strength and are not meant to include skill as a factor in the total performance (and the kip-kick method requires some skill), this method should not be used as a substitute for a test of shoulder and arm strength and endurance.

The Validity of Heart Rate and Blood Pressure Determinations As Measures Of Physical Fitness

By Elizabeth Powell Salit and W. W. Tuttle

State University of Iowa, Iowa City, Iowa

(Submitted for publication, June, 1944)

IT is generally believed that among normal people a low resting pulse and systolic blood pressure, a small increase in both due to moderate exercise, and a prompt return to normal, are characteristic of persons in superior physical condition. Some indication of the validity of these ideas is presented in this paper, and suggestions are made for pursuing this subject further.

COLLECTION OF DATA

Data for the experiment were obtained from 20 college men and 40 college women. Half of the subjects in each of these groups participated regularly in vigorous exercise; the others had little or no such exercise. Each subject came to the laboratory on four occasions at about weekly intervals. Heart rate and blood pressure determinations were made in a reclining position after 5 minutes of bed rest and after a minute of standard exercise on the bicycle ergometer. Three post-exercise determinations were made: a half minute after the exercise was completed, then at 2 and 4 minutes. For most of the subjects (19 of the 20 college men and 30 of the 40 college women) records of maximum work output for 2 minutes on the bicycle ergometer were also available.

CRITERIA OF PHYSICAL FITNESS

Several methods of estimating physical fitness were used in this study. In the first place those who reported regular vigorous physical activity were assumed to be in better physical condition than those who were less active. In the second place, objective criteria were derived from the records of maximum work output.

The total work done in two minutes is in itself a criterion of fitness, but it is related largely to body size and strength rather than to the adequacy of cardiovascular adjustments to exercise. For the 20 college men, the correlation between work output and body weight was .606. The regression equation based on this correlation shows that the kilogram meters of work expected on the basis of body weight was 17 times the weight in kilograms plus a constant

of 448. This formula was used to compute, on the basis of body weight, how much work each man should do.

The differences between actual and predicted work could be due to differences in muscular strength over and above those already accounted for in terms of body weight, or to differences in cardiovascular efficiency. Those individuals who did more work than was expected for their size were evidently in better physical condition than those who did less than the expected amount. The difference between actual and predicted work is therefore superior to the actual work output as a criterion against which cardiovascular tests of fitness can be validated.

The validity for men, of both the activity and the work difference criteria of physical fitness, is indicated by the fact that there is 70 per cent agreement in classifying the 20 men into high and low groups. Seven of the 10 men reporting vigorous activity are ranked among the first 10 according to the work difference criterion. The lower ranking of the other three is in line with the findings of case studies.

A similar procedure was not carried out in the case of the 40 college women because work output and body weight were not significantly correlated. Total work output for two minutes was used as the objective criterion for the women.

CARDIOVASCULAR SCORES AS MEASURES OF PHYSICAL FITNESS

The average heart rate and blood pressure scores for vigorously and moderately active groups of college men and women, and the group differences are shown in Table I. * With few exceptions group differences are small, indicating that most cardiovascular measures do not provide a good means of selecting individuals who are in superior physical condition. Of all the scores obtained in this study, the post-exercise heart rate and the increase due to exercise are the most promising.

Attention should be called to the fact that the amount of recovery in heart rate between the first and the second post-exercise scores for the men was 13 beats less for those who were known to be in superior physical condition. They had a smaller increase due to exercise and therefore had less to recover from than the men in the less active group. In the case of the women, the standard exercise was strenuous enough to produce about the same increase in both groups. Under these circumstances the superior group would be expected to have a greater recovery. As a matter of fact, the superior group does show a slightly greater recovery between the first and second post-exercise averages.

* Tables will be found at end of article.

The blood pressure measures appear to be altogether useless in distinguishing between healthy young adults who obviously differ in physical fitness. The situation was similar with respect to pulse pressure (the difference between systolic and diastolic pressures). Therefore, the pulse product (heart rate times pulse pressure) would be of use only because of the possible validity of the heart-rate factor.

In order to evaluate the differences obtained in Table I the *t*-test was applied (see Table II). The *t*-ratio is the difference between two group means divided by the standard error of the difference. The distribution of such ratios is known, and tables have been prepared to show what the probabilities are of obtaining various ratios. When a *t*-ratio for 20 cases (18 *d. f.*) is 2.9 we can be certain at the 1 per cent level of confidence that the difference between the two groups of 10 is a real one, i. e., not due to chance. A *t*-ratio of 2.6 provides the same degree of certainty for 40 cases (38 *d. f.*).

The only cardiovascular measures that show significant differences between the vigorously and moderately active groups of men at the 1 per cent level of confidence are the pulse a half minute after exercise and the increase due to exercise. Among the women there are no significant differences between the scores of the two groups (see Table II).

These results are not unexpected because the amount and strenuousness of physical activity was more marked for the vigorously active men than for the women. Most of the men in the vigorously active group were in regular training for intercollegiate athletics, whereas the activity program for the corresponding group of women was not highly competitive.

The greatest difference in heart rate between the two groups of women was obtained two minutes after the standard exercise. Although the pulse increase due to exercise was only one beat less for the more active group, the recovery was more rapid. Apparently the optimum time for obtaining significant individual differences in the post-exercise heart rate varies with the strenuousness of the exercise. Any standard exercise would be more strenuous for women than for men because they have less muscular strength. The same line of reasoning applies to groups of men or women who differ markedly in size and strength. It is entirely possible that cardiovascular scores merely reflect the relation between an individual's strength and the work he is called upon to do. This idea was supported by the results obtained when the men were classified according to work difference and the women according to 2-minute work output (see Table III). The differences between the high and low groups are somewhat smaller than those shown in Table I.

HEART RATE AND BODY WEIGHT

When body weight was correlated with various heart-rate scores the following coefficients were obtained:

	Men	*Women*
Resting heart rate	.231	—.189
Pulse a half minute after exercise	—.299	—.195
Pulse two minutes after exercise	—.105	—.374
Increase due to exercise	—.532	—.074

The coefficients of correlation given indicate that the smaller men had lower resting heart rates than the larger men, and that they had to exert themselves in doing the standard exercise to such an extent that their post-exercise rates were higher than those of the larger men. There were several notable exceptions to this in the group of athletes. Among the women the inverse relationship was greatest 2 minutes after exercise; the larger women not only had slower pulses to begin with, but they also recovered more rapidly after the standard exercise.

Variability in weight was greater among the men than among the women as indicated by the standard deviations which were 12.95 and 9.21 kilograms, respectively. This might account in part for the greater differences in the strenuousness of the standard exercise for the two groups of men than for the women, and consequently for the greater differences in heart rate a half minute after exercise and in the increase due to exercise.

PULSE DIFFERENCE AS A MEASURE OF PHYSICAL FITNESS

The pulse increase scores for the men were adjusted for body weight according to the procedure already described for deriving the 2-minute work difference, i.e., a regression equation was used to determine what a man's pulse increase should be according to his body weight. (Pulse increase $= 59—.45 \times$ body weight.) The average pulse increase for the vigorously active group of men was 4 beats less than the predicted increase. The average for the moderately active group was 6 beats more than the predicted increase. The difference of 10 beats between these two averages is significant, well above the 1 per cent level of confidence ($t = 3.1$). Only one individual in the moderately active group had an appreciably smaller pulse increase than was predicted, and none of those in the vigorously active group had an increase of more than one beat above the predicted increase.

This analysis confirms the idea that men who participate in vigorous physical activity are superior to less active individuals with respect to certain circulatory adjustments to exercise. It is possible, of course, that the pulse differences merely reflected differences in strength which were not accounted for in terms of body weight.

CONCLUSIONS

Resting and post-exercise heart rate and blood pressure scores for 20 college men and 40 college women were studied in relation to several criteria of physical fitness. The increase in pulse and the pulse a half minute after the standard exercise on the bicycle ergometer were the most valid measures of fitness for men. For women the pulse two minutes after the standard exercise was the best. It is suggested, however, that cardiovascular tests be validated in relation to a work output criterion in which allowances are made for differences in strength as well as for differences in body size.

TABLE I

COMPARISON OF CARDIOVASCULAR SCORES MADE BY PARTICIPANTS IN VIGOROUS AND MODERATE PHYSICAL ACTIVITY

		After Exercise			*Increase Due to Exercise*	*Recovery Between*	
	Resting	*½ min.*	*2 min.*	*4 min.*		*½ min. and 2 min.*	*2 and 4 min.*
				Heart Rate (beats per minute)			
Men:							
10 Vigorous	67	82	68	68	15	14	0
10 Moderate	71	103	76	71	32	27	5
Differences	4	21	8	3	17	13	5
Women:							
20 Vigorous	68	109	79	74	41	30	5
20 Moderate	73	115	87	81	42	28	6
Differences	5	6	8	7	1	-2	1
				Systolic Blood Pressure (mm. Hg.)			
Men:							
10 Vigor.	123	145	135	129	22	10	6
10 Moder.	117	145	133	126	28	12	7
Differences	6	0	2	3	-6	-2	-1
Women:							
20 Vigor.	106	140	122	113	34	18	9
20 Moder.	108	140	124	116	32	16	8
Differences	-2	0	-2	-3	2	2	1
				Diastolic Blood Pressure (mm. Hg.)			
Men:							
10 Vigorous	75	72	71	71	-3	-1	0
10 Moderate	74	72	71	71	-2	-1	0
Differences	1	0	0	0	1	0	0
Women:							
20 Vigorous	68	63	61	62	-5	-2	1
20 Moderate	69	67	65	66	-2	-2	1
Differences	-1	-4	-4	-4	3	0	0

TABLE II

SIGNIFICANCE OF THE DIFFERENCES BETWEEN VIGOROUSLY AND MODERATELY ACTIVE GROUPS WITH RESPECT TO HEART RATE AND PULSE DIFFERENCE (*t*-TESTS)

	Men—10 in Each Group			*Women—20 in Each Group*		
	Resting Pulse	*½ Min. Increase After Exercise*	*½ Min. Increase Due To Exercise*	*Resting Pulse*	*½ Min. Increase After Exercise*	*½ Min. Increase Due To Exercise*
Difference	4	21	17	5	6	1
S.E. (diff)	3.4	4.4	3.1	2.7	3.9	3.6
t	1.3†	4.8*	5.7*	1.9†	1.5†	.3†

* Significant at the 1 per cent level of confidence
† Not significant

TABLE III

COMPARISON OF CARDIOVASCULAR SCORES MADE BY HIGH AND LOW GROUPS CLASSIFIED ACCORDING TO WORK DIFFERENCE FOR MEN AND TOTAL WORK OUTPUT FOR WOMEN

	Heart Rate			*Systolic Pressure*		
Subjects	*Resting*	*½ Min. After Exercise*	*Increase Due To Exercise*	*Resting*	*½ Min. After Exercise*	*Increase Due To Exercise*
Men: 10 High	69	88	19	122	148	26
10 Low	69	97	28	118	143	25
Differences	0	9	9	4	5	1
Women: 15 High	71	110	39	106	137	31
15 Low	72	115	43	109	144	34
Differences	1	5	4	3	7	3

A Study of Arm and Shoulder-Girdle Strength of College Women In Selected Tests

By MARJORIE WILSON

State University of Iowa
Iowa City, Iowa

(Submitted for publication, March, 1944)

RECENT emphasis on physical fitness and endurance has brought about a renewed interest in strength. Since mass exercise programs have come into popular favor, strength testing to determine the effectiveness of these programs is a logical and necessary requisite.

Because dynamometers, which provide a quick and reasonably satisfactory method of measuring strength, are almost impossible to procure during a war era, the development of a test battery utilizing minimal and simple equipment seems practical. Such a battery based on performance tests is one of the objectives of this study. The tests are all limited to the arm and shoulder girdle in accordance with McCloy's theory that arm strength is as accurate a predictor of general motor ability as is total strength.[1]

STATEMENT OF THE PROBLEM

The purpose of this study is threefold: (1) to make an analysis of several selected performance tests in relation to strength; (2) to devise a simple battery of tests to be used when machine testing devices or special apparatus are not available; and (3) to evaluate and classify the selected performance tests.

PROCEDURE

The subjects for this investigation were all major students, graduates and undergraduates, in the department of physical education for women at the State University of Iowa. Fifty-two women completed all tests. Physical education majors were selected as subjects in the belief that they could be motivated more readily to approximate maximal strength output than could non-majors.

In order to establish criterion scores, grip strength, push

1 McCloy, C. H., "The Apparent Importance of Arm Strength in Athletics," *Research Quarterly*, 15:1 (March, 1934), pp. 3-11.

strength, and pull strength records were taken on a rectangular type hand dynamometer and a "push and pull" attachment to this instrument. All tests, including right and left grips, were alternately repeated. Push-up tests and pull-up tests were also used as criterion scores.

The performance tests used in this study are direct selections from, or modifications of, tests suggested in strength testing literature and self-testing stunts. The tests were chosen on the basis of minimal equipment requirement, ease of administration and scoring, and diversity. Descriptions and scoring of the eleven performance tests may be found at the end of this article.

To substitute for the dynamometer and attachment, which at present are difficult to procure, three tests of strength were devised utilizing an ordinary 150-pound spring scale, a small pulley, rope, and a convenient grip handle. Reliability coefficients for these tests are: .913 for Horizontal Thrust, .912 for Vertical Pull, and .816 for Horizontal Pull. The lower coefficient for the horizontal pull is undoubtedly due to difficulty in standardizing administration procedures. Descriptions of these substitute tests may be found at the end of the article.

DISCUSSION OF DATA

Reliability correlation coefficients were calculated for the sum of the right and left grips, the dynamometer pull score, and the dynamometer push score by the Pearson product-moment method. These correlations were found to be: .937 for the sum of Right and Left Grips, .893 for Dynamometer Pull, and .764 for Dynamometer Push. The somewhat lower coefficient for the push scores may be due to the mechanical structure of the "push and pull" attachment. When a great deal of pressure is exerted on this attachment the grooved handle tends to cut the palms of the hands. Unless the hands are thickly callused, it is difficult to obtain two similar measures because of the pain involved. A pad of tape on the handles would probably eliminate some of the discrepancy in scores. Since the higher of the two scores was used in computing the index, that index derived from the pull scores is probably more reliable than the reliability coefficient indicates. According to Rogers[2] if push and pull tests are efficiently conducted, correlation coefficients of reliability will be well above .90.

Rogers' Short Index[3] was selected as a criterion because of its extensive use and popularity in past testing and because it places

---

2 Rogers, F. R., *Physical Capacity Tests*, (New York: A. S. Barnes and Company, 1931).

3 3 × the sum of the right and left grips plus (pull-ups + push-ups) × $\left[\frac{\text{weight}}{10} \times (\text{height} - 60)\right]$

emphasis on strength of the upper extremities. The push-up and pull-up tests were administered according to Rogers' directions, with the exception of the use of parallel bars instead of rings for the pull-ups.

Zero-order correlations of strength tests with the above criterion follow in descending rank order:

1. Pull-up	.797	7. Sum of Pull & Push Scores	.492
2. Push-up (knees	.717	8. Bent-Arm Hang	.471
3. Push-up (bench)	.632	9. Weight Holding	.418
4. Vertical Pull	.594	10. Walrus Walk	.394
5. Modified Pull-up	.572	11. Basketball Throw	.341
6. Rope Climb	.509	12. Self-Support	.319

All of these tests except the basketball throw and the self-support are significant for 52 cases at the one per cent level of confidence; the basketball throw is significant at the two per cent level.

The intercorrelations of significant performance tests and reliable machine tests are shown in Table I. Two-item combinations were selected for a battery because more than two items consumes too much time and hence is not practical in mass testing programs. Those items possessing a high validity coefficient and a low intercorrelation were combined in multiple correlations with Rogers' Index. The results of these calculations are given in Table II. Any of the first six batteries may be used as an effective measure of strength in a situation similar to the one presented in this study.

TABLE I

INTERCORRELATIONS OF PERFORMANCE TESTS AND MACHINE TESTS OF STRENGTH

	1	2	3	4	5	6	7	8	9
1. Bent-Arm Hang									
2. Push-up (knees)	.426								
3. Push-up (bench)	.537	.756							
4. Pull-up	.556	.676	.626						
5. Modified Pull-up	.537	.479	.526	.581					
6. Basketball Throw	.015	.063	.042	.100	.226				
7. Rope Climb	.520	.614	.623	.622	.462	.134			
8. Weight Holding	.339	.328	.373	.270	.402	.270	.115		
9. Push and Pull Scorers	.246	.265	.102	.271	.302	.436	.269	.212	
10. Vertical Pull	.228	.287	.096	.349	.229	.496	.283	.226	.611
11. Walrus Walk		.350		.446					.163

TABLE II

MULTIPLE CORRELATIONS OF TWO-ITEM COMBINATIONS OF STRENGTH TESTS IN RELATION TO ROGERS' SHORT STRENGTH INDEX

Strength Tests	*R*
Pull-up—Vertical Pull	.865
Pull-up—Sum of Push and Pull Scores	.850
Pull-up—Basketball Throw	.839
Vertical Pull—Push-up (bench)	.829
Pull-up—Weight Holding	.823
Vertical Pull—Push-up (knees)	.823
Push-up (knees)—Sum of Push and Pull Scores	.785

Push-up (knees)—Basketball Throw	.775
Sum of Push and Pull Scores—Push-up (bench)	.766
Push-up (knees)—Modified Pull-up	.763
Vertical Pull—Modified Pull-up	.755

The formulas for deriving the strength score of suggested combinations were computed by means of the regression equation and are listed below in simplified form:

(1) .5 Pull-up + 1. Vertical Pull
(2) 2.9 Pull-up + 1. Sum of Push and Pull
(3) 1. Pull-up + .3 Basketball Throw
(4) .9 Vertical Pull + 1. Push-up (bench)
(5) 3.8 Pull-up + 1. Weight Holding
(6) .7 Vertical Pull + 1. Push-up (knees)

SUMMARY OF DATA

A careful inspection of the data yields the following observations that seem to apply adequately to college majors in physical education.

1. Strength can be measured by performance tests with a relatively high degree of validity according to the criterion used in this study.

2. Six batteries are very satisfactory and may be used interchangeably depending upon the time and equipment available.

3. Two batteries, the pull-up and weight-holding combination and the pull-up and basketball-throw combination, eliminate the use of any machine-testing device.

4. If time limitation is an important element in the testing program, the vertical pull and the push-up from the knees combination is suggested. The push-up test may be given as a mass test, with partners alternately scoring and performing the test. The vertical pull can be administered much more quickly than most individual tests.

5. The pull-up and push-up tests show the highest zero-order correlation with the criterion. These correlations may be somewhat high because both push-up and pull-up tests are a part of the criterion.

EVALUATION AND CLASSIFICATION OF PERFORMANCE

Knowledge of the degree of difficulty of a test is valuable in devising a testing program because strength tests do not discriminate if they are too difficult for the group to be measured. The eleven performance tests used in this study were ranked according to difficulty by two methods: (1) a percentile ranking derived from superimposed ogives with each range of measures graphed on the same horizontal axis, (2) the ratio of the mean to the highest score in each distribution. The same difficulty ranking was obtained by both

methods and is given below with the progression from the most difficult to the easiest test.

TABLE III

DIFFICULTY RANKING OF PERFORMANCE TESTS

Ranking	*Strength Tests*	*Percentile*	*Ratio*
1	Push-up (floor)	87	.133
2	Rope Climb	82	.138
3	Push-up (bench)	62	.290
4	Bent-Arm Hang	48	.336
5	Self-Support	43	.343
6	Weight Holding	29	.414
7	Pull-up	25	.423
8	Walrus Walk	24	.434
9	Push-up (knees)	18	.438
10	Modified Pull-up	15	.467
11	Basketball Throw	0	.757

Push-up Tests.—The chief weakness of the push-up tests is the problem of determining the degree of difficulty of the test necessary to measure a specific group with adequate discrimination. The difficulty of the push-up from the bench may be increased by diminishing the angle of the arms from the bench, that is, by bringing the shoulders more directly over the hands. In this position a greater share of the trunk weight must be lifted, and less weight rests on the braced feet.

The negative correlation of weight with push-ups ($r = -.259$) and that of height with push-ups ($r = -.304$) indicates that the tall, heavy girl is unduly penalized in this test. Part of these results is probably due to the seemingly precarious position that the tall girl must assume. So much of her body is without support that she feels she is incapable of exerting any strength in such a position. Previous experience with the test would help to overcome this insecure feeling.

There is very little muscle soreness from the push-up from the knees test and a moderate amount in the deltoid resulting from the push-up from the bench. Push-ups from the floor affect the abdominal muscles in most subjects unless they are trained.

Pull-up Tests.—The pull-up test is superior to the modification because no adjustment is made in the modification for differences in height. For those who are not familiar with the modified test, there is also the difficulty of locking the ankles in position so that the lower leg remains perpendicular to the floor and the shoulders remain directly under the bar. If the angle at the ankle is changed, the modified test reverts into the original pull-up, without a bar adjustment. With sufficient practice before the test was given the modified pull-up might produce a higher correlation with the criterion.

Muscle soreness seems to be concentrated in the anterior deltoid

and pectoralis major for the pull-up test and in the forearm for the modified pull-up. Those who have had no training for a testing program may have a painful reaction in the latissimus.

Self-Support.—The self-support, because of pain in the palm of the hands from the pressure of the body weight, seems to test the sensitivity of the nerves of the palm rather than strength. If a sponge rubber padding could be used on the bands, this weakness might be partially avoided. If the pain could be eliminated, the test would become so easy for many subjects that they might cease to support themselves from sheer boredom.

Muscle discomfort, resulting from the self-support, tends to be most acute during the exercise and immediately following. This is probably the result of an accumulation of fluid due to the sustained downward position of the arms and an interference with circulation from the constant, hard pressure on the hands. Massage or a hot bath tends to relieve this edema.

Bent-Arm Hang.—The scores of the bent-arm hang tend to vary inversely with weight ($r = -.349$). Those individuals with small hands and a great deal of weight seem to have difficulty in maintaining their grasp on the bar. A bar with a smaller circumference than those on the regulation stall bar might eliminate this weakness.

Muscle discomfort, as in the case of the self-support, tends to be acute during the exercise. The complete flexion of the elbow may hamper circulation and cause the numb, uncomfortable feeling in the arms. Because of this sensation many subjects cease the exercise before they are exhausted, and this test is not a true test of strength. Post-exercise soreness in the upper pectoralis major is almost inevitable.

Basketball Throw.—There is a definite positive correlation of .568 between the scores for basketball throw and weight and a positive correlation of .550 with height. The bigger, heavier girls have the advantage both in height and stabilization of the body.

Most subjects are willing and anxious to take this test probably because they are familiar with throwing exercises, because they feel they can excel in such a test, and because they know there will be no resultant muscle soreness.

Further experimentation on a larger number of cases with better standards of administration might produce a higher correlation with the criterion.

Rope Climb.—The chief weaknesses in the rope climb are the difficulties of administration and scoring. The test is too difficult; too many girls fall in the zero scoring category and hence the test is not discriminating.

Weight Holding.—The need for strong motivation was apparent in the administration of this test. Subjects tend to stop before it is necessary because the position soon becomes uncomfortable and because it takes a great deal of concentration to maintain the original trunk position. A weight was selected which was heavy enough to limit the range of scores and yet light enough to avoid a large number of zero scores, in an attempt to minimize the above weakness. There may be some resultant muscle soreness in the middle deltoid.

Walrus Walk.—The low correlation of this test with the criterion may be due in part to an element of skill. Those subjects who were familiar with the test and had practiced it prior to the testing program, seemed to have more confidence in their ability and seemed to receive better scores. If all subjects were trained in the skill before testing, the test might produce a higher correlation with the criterion.

This test depends to some extent on the ability to fix the abdominal muscles, as is shown by the resulting muscle soreness in that area.

In summary of the above evaluations it seems pertinent to state that (1) performance tests can be ranked in order of difficulty to facilitate the building of a testing program that will discriminate, and (2) the low zero-order correlation of some of the performance tests is probably due to a weakness within the tests. Further experimentation with improved tests would be desirable.

DESCRIPTION OF TESTS

Performance Tests

1. *Basketball Throw.*—The cross bar on a jump standard is adjusted to a chest-high position for each girl, the adjustment made with the hands overhead. The subject stands, holding a regulation basketball overhead with both hands, with her chest contacting the cross-bar. She is told to throw the ball as far as possible with the trunk fixed and movement confined to the arms and hands. Three-foot markings on the floor running from ten to thirty-five feet from the standard will facilitate the scoring.

Score: The best of three properly executed trials measured to the nearest foot.

Fouls. To dislodge the cross-bar
To step in any direction
To jump
To hyperextend head or trunk

2. *Rope Climb.*—A free-hanging rope, with a knot at the bottom, is marked in one-inch intervals from approximately four and one-half feet to the top of the rope. (Colored yarns, threaded through the rope and tied firmly, serve as a convenient and satisfactory method of marking.) The subject stands erect on the knot with the hands so placed that the chin is in line with the point of contact between the hands. As soon as this position is

assumed and the examiner has noted the starting point, the subject is told to remove her feet and pull herself up, hand over hand, without the use of her legs.

Score: The scores fall into two groupings:

(a) If the subject is unable to maintain this position, without the use of her feet or legs, or is unable to move her hands, she is scored a zero.

(b) If the subject can maintain the position and can move either or both hands, her score is the difference in inches between her original starting point and the highest point touched on the rope by either hand. If the subject feels that her first attempt was not representative of her ability, she may have a second trial with the better score recorded.

Fouls: To touch floor with feet
To grasp rope with either feet or legs

3. *Walrus Walk.*—The subject takes a front leaning-rest position on the hands behind a restraining line, with legs completely extended and immobile. She is told to walk forward on her hands as far as possible, dragging her feet. No part of the body except the hands and feet may contact the floor. She may pause momentarily to regain balance if necessary. She may progress at her own rate of speed.

Score: The distance covered measured to the nearest foot, from the restraining line to the farthest point touched by either hand before the subject collapses.

Fouls: To use feet in advancing
To let hips sag to the floor

4. *Bent-Arm Hang.*—A high bar is placed at such a level that the subject can stand on a stool and come to the bent-arm position. The subject grasps the bar with palms facing in, the chin well above the bar, hands shoulder width apart, and arms at full bend. On the command "go" she lifts her weight off the stool, hangs suspended, and the examiner removes the stool. This test may also be given on the stall bars. The subject selects a suitable cross bar on which to stand and, on signal, releases her feet from the bar and hangs with toes pointing downward. The fact that her body sways against the bar does not effect the final results as long as the scores are used in relative measures and no direct comparison is made with other bent-arm hang scores or norms.

Score: The time in seconds, from the signal "go" until the chin falls below the level of the bar.

5. *Weight Holding.*—The subject stands erect, assuming a ten- to twelve-inch stance, with right arm completely extended shoulder high, palm facing up. (For right-handed subjects). The other arm hangs free at the side. An upright standard is placed in front of the subject to serve as a gauge of body alignment for both the subject and examiner. If the test is administered a few inches from a wall marked with horizontal lines at shoulder heights, it will be easier to note the drop of the weight-bearing arm. The examiner momentarily places an eight-pound shot in the subject's upturned palm to determine the amount of resistance necessary to counteract the weight. The subject is allowed to relax before the test is started. When the weight is placed in her hand a second time, she is told to hold it as long as possible, maintaining her original posture.

Score: The time in seconds the subject can hold the weight.

Fouls: To change stance
To flex arm at any point, wrist included

To drop weight-bearing arm below shoulder level
To shift body alignment—hips, shoulders, or head

6. *Self-support.*—The subject stands on a bench at the ends of parallel bars, grasping the bars, one in each hand, with arms straight. At the command "go" the stop watch is started and the bench removed. In case parallel bars are not available, the subject may stand on the floor, hands on the backs of two chairs, with arms straight and at the signal "go" pull herself to suspended position.

Score: The time in seconds that the subject can maintain this suspended position.

Fouls: To contact the floor

7. *Push-up from the Knees.*—The subject assumes a front leaning-rest position on the hands and knees with the lower leg in any position that is comfortable. A slight flexion at the hips (through approximately five degrees) is necessary to prevent the thighs from contacting the floor. From this position the subject lowers her chest to the floor by bending the elbows and returns to original position by straightening the arms. (If mats are available to protect the knees, the score will be a more accurate measure in most instances).

Score: The number of complete dips, properly executed.

Fouls: To rest on floor between dips
To flex hips beyond starting position at any time
To let hips sag

8. *Push-up from the Bench.*[4, 5]

9. *Push-up from the Floor.*[4]

10. *Pull-up.*[4, 5]

11. *Modified Pull-up.*[6]

Substitute Tests

1. *Vertical Pull.*—The lower end of the scale is fastened to the floor. A rope securely fastened to the upper end of the scale, is run through an overhead pulley so that the handle end can be reached from a standing position with the arm slightly flexed. The length of the rope should be adjusted to the height of the shortest girl. Further adjustments for taller girls may be made by slipping a wooden peg through one or more loops of the rope. Standing erect, with a comfortable stance and with shoulders fixed, the subject pulls as hard as possible without flexing knees or hips.

Score: The number of pounds, to the nearest pound, registered on the scale. The examiner must squat to the level of the scale in order to read it correctly.

2. *Horizontal Thrust.*—The lower end of the scale is fastened to the floor. The rope attached to the upper end passes through a wall pulley which is located about three inches above the shoulder height of the tallest girl. Several low platforms of varying heights make it possible to adjust approximately the height for all shorter girls. The subject stands with heels, hips, and shoul-

[4] Rogers, F. R., *op. cit.*

[5] McCloy, C. H., *Tests and Measurements in Health and Physical Education,* (New York: F. S. Crofts and Company, 1939), pp. 32-33.

[6] McCloy, C. H., "Home Calisthenics," *Journal of Health and Physical Education,* 14:1 (January, 1943), pp. 15-18.

ders against the wall and grasps the handle with her right hand, palm facing downward. The length of the rope should be so adjusted that the hand is close to and in front of the shoulder, with the elbow completely flexed. The other arm hangs free at the side. The subject then pushes in a horizontal plane as far as possible while bracing herself against the wall. She should be cautioned to keep complete contact with the wall throughout the thrust.

Score: The number of pounds, to the nearest pound, registered on the scale.

3. *Horizontal Pull.*—Using the arrangement mentioned above, the subject faces the wall and grips the handle with the palm facing up. The distance from the wall is so adjusted that the arm, when at rest, is slightly flexed. An eighteen-inch diagonal stance, measured from heel to heel, is taken so that the pulling side is closest to the wall. The trunk is upright with the weight equally distributed between the feet. The body is locked and maintained in this position throughout the test. An upright standard contacting the hips and shoulders serves as a gauge in maintaining this position.. The subject then pulls, without jerking.

Score: The number of pounds, to the nearest pound, registered on the scale without change in the subject's original position. It would be well for the examiner to have an assistant to read the scale while she checks body position..

Research Abstracts

Prepared by the

NATIONAL COUNCIL OF THE RESEARCH SECTION

HEALTH AND NUTRITION

Elvehjem, C. A., "Newer Findings in Vitamin Research," *Journal of the A. D. A.*, 19:11 (November, 1943).

Dr. Elvehjem is a well known person in the field of nutrition and biochemical research. In regard to vitamin requirements he states that the recommended daily allowances set up by the Food and Nutrition Board of the National Research Council are values used to represent *optimum* nutrition. The best scientific evidence indicates that they are as nearly right as possible at our present state of knowledge. He cites such reasons as variations in human vitamin storage, differences in nutritional background, and varying lengths of studies as explaining why there are differences in opinion as to actual requirements.

Since greater standardization of methods of analysis has occurred he believes that we can accept most vitamin values from food tables with considerable confidence. He emphasizes the importance of a well rounded diet and proper combination of all food groups in accomplishing good nutrition. Concerning the vitamin content of food as consumed he rates the loss in processing above that likely in cooking and gives as an example whole grain cereals made into ready-to-eat cereals. Losses by improper storage of many foods are also important.

In closing, he discusses briefly the newer factors. According to present knowledge pyriodoxine, pantothenic acid, and others are generally distributed and there is little danger of a deficiency occurring in man.—*Alice H. Smith.*

Johnston, F. A., "The New Theory of Iron Metabolism," *Journal of the A. D. A.*, 19:12 (December, 1943).

In this article Miss Johnson of the University of Chicago briefly describes the old theory of iron metabolism and goes into detail concerning the new one. Recent work by well known research persons in this field indicates that it is time for us to revise our thinking along this line.

The highlights of the new theory are as follows: Only a small proportion of the iron present in the food we eat is actually absorbed into the body and of that amount very little is excreted as waste. It is thought that most of the iron used in the body is formed then by the disintegration of red cells. It appears that the body uses its iron over and over again. If this is the case then not much new iron from food would be metabolized each day.

Studies show that men lose little iron each day and almost any diet will replace it. The fact that nutritional anemia is rare in men substantiates this. Women lose little by ordinary excretion but during menses there is considerable loss which must be replaced. The fact that nutritional anemia is common among women during reproductive years is an indication not only of iron deficiency but also of other factors needed for hemoglobin formation. There is greater need during pregnancy. In general it is felt that the standard of 12 mg. per day set up by the National Research Council is very generous.

For children allowance must be made for their growing blood volume and the new tissue being built.—*Alice H. Smith.*

Carr, L. G., "Survival Foods of the American Aborigine," *Journal of the A. D. A.*, 19:12 (December, 1943).

Mr. Carr of the Department of Anthropology, University of Pennsylvania, reports here the results of an extensive study of food practices of the American Indian.

It has been noted that as long as the Indian generally relied on the food from woods and stream he usually remained in good health but when he adopted the refined foods of the white man he was attacked by dental caries and degenerative diseases. They were not aware that many of their foods and medicinal herbs contained valuable minerals and vitamins but through trial and error they had established certain food practices which proved beneficial to them. Now at a time when we must practice food economy at home and when many of our soldiers are in parts of the world where transportation of food is difficult, it behooves us to take note of what the fields and woodlands have to offer.

Many tribes of American Indians, as well as aborigines all over the world, use acorns for a meat substitute, as flour, and make various uses of the extracted oil. Other plants used for flour are, the common and available cat briar ("Smilax"), root of the common cat-tail, bulb plants. Persimmon is especially rich in vitamin C and is palatable in many forms. The value of greens and cresses is recognized by all Indians. Dandelion, turnip greens, peppergrass, and water-cress are the most common and are all very nutritious. —*Alice H. Smith.*

Winters, Jet Corine, and Ruth Elizabeth Leslie, with the technical assistance of Catherine Donnell, "A Study of the Diet of Twenty Women in a Moderate-Income Group," *J. Nutrition*, 27:2 (February, 1944).

The present investigation of the nutritive value of the diets of women in a moderate income group was undertaken to supplement data previously obtained on a low-income level. Diet samples were collected from twenty women, twelve of whom constituted a group comparable to the low-income mothers previously reported on. The other eight subjects were faculty members and students of the Department of Home Economics. Samples were collected which duplicated in kind and amount the food consumed daily, and were assayed as in the low-income study for thiamine by the fermentometer method, for riboflavin, niacin, and pantothenic acid by microbiological methods, and for protein, calories, and minerals by standard procedures.

The calorie intakes of the twenty women studied varied from one-half to four-fifths of the allowance recommended for the moderately active woman by the National Research Council. In comparison with the same standard, the intake of riboflavin was four-fifths, of niacin, three-fifths, of thiamine, one-half adequate. There was no deficiency of protein and calcium. Pantothenic acid intake was less than half the amount suggested as adequate by R. J. Williams.

The intakes of the moderate-income group are larger than those of the low-income group by the following percentages: calories, 45%; protein, 77%; calcium, 145%; phosphorus, 30%; riboflavin, 120%; pantothenic acid, 99%; niacin, 120%; thiamine, 47%.—*The Wistar Institute.*

Cannon, Paul R., "Protein Metabolism and Acquired Immunity," *Journal of A. D. A.*, 20:2 (February, 1944).

It has been assumed that a relationship exists between nutrition and resistance to infection but there has been little evidence to support the theory. Throughout life defense against infection depends largely upon the individual's ability to acquire immunity by building up an efficient anti-body mechanism.

The antibodies have been found to contain protein and are dependent on dietary amino acids for synthesis. Recent experiments at Harvard substantiate this and show that many of the already proved essential amino acids for humans are necessary for antibody formation. Such diseases as typhoid, rheumatic diseases, and pneumonia were studied.

In summary Dr. Cannon stresses the fact that the total dietary should be adequate, making sure that sufficient protein is present and that at least half of it of high biological value (such as that found in milk, meat, cheese, fish and poultry). He points out that starvation leads people into a dangerous state of hypoproteinemia or protein deficiency which in turn may bring on various infections and complications. Good nutrition and sufficient high quality protein would avoid this by supplying the building stones necessary for antibodies.—*Alice H. Smith.*

Editorial, "The Problems of Changing Food Habits From the Viewpoint of Cultural Anthropology," *Journal of A. D. A.*, 20:3 (March, 1944).

In this editorial a summary of the activities of the Committee on Food Habits of the National Research Council is presented. (The recent publication of this committee is entitled *The Problem of Changing Food Habits*, Bulletin No. 108, and may be obtained upon request from the Publication Office, National Research Council, 2101 Constitution Ave., Washington, 25, D. C.) Studies were made by leading sociologists, doctors, and people in the fields of food and nutrition, of the food habits of various nationality groups such as Italian, Central Europeans, Negroes, Greeks, Norwegians, and Chinese.

One immediate use of the material gained from these studies is the relief of malnutrition in liberated countries by sending nutritious foods they will eat and educating them to a well rounded diet.

Other studies were made of various rural groups in different sections of the United States. This brought to light a multitude of interesting information not only on actual food intake but also on attitudes, superstitions, and all sorts of conceptions concerning what food should be eaten, when, and how. Many faulty food habits were discovered even among war workers and federal employees.

In the conclusions some of Dr. Margaret Mead's statements on the problem of actually changing food habits are quoted.—*Alice H. Smith.*

Boyd, J. D., "The Need for Betterment of Children's Diets," *Journal of the A. D. A.*, 20:3 (March, 1944)

Recent studies at the College of Medicine, State University of Iowa, have convinced Dr. Boyd and co-workers that the majority of children are not receiving adequate diets and much improvement should be made.

Children on controlled diets (adequate according to National Research Council standards) were observed for responses to such a regimen. The average length of observation was 5 years for each child. The following conclusions on teeth were drawn: diabetic children had a lower rate of caries progression than others; little advance in caries was observed in the other children except those who failed to conform to the dietary regimen. Dr. Boyd describes the conflicting theories on the cause of tooth decay. Then he summarizes the Iowa findings by saying that the factors of fluorine content of water, high or low fat content of diet, and restriction of sugar did not

seem to be the important things in determining the extent of caries. An adequate diet of protective foods plus only enough concentrated sweets to give sufficient calories seemed to give best results.

In conclusion Dr. Boyd lists several faulty diet practices which lead to undernutrition in children such as, poor breakfasts, small lunches, poor choice of food by child, improper balance between "high calorie" and protective foods and emphasizes that we must all intensify our program of educating children and their families in better dietary practices.—*Alice H. Smith.*

Davis, William A., and Charles M. Wheeler, "The Use of Insecticides on Men Artificially Infested with Body Lice," *Am. J. Hyg.*, 39:2 March, 1944).

The delousing of men by means of powders and sprays was studied as part of a program for the control of typhus fever. Volunteers were artificially infested with body lice (*Pediculus humanus corporis*). The subjects were observed until the infestation was increasing and then treated. Two powders studied were found to be safe and effective for about a week. "They are recommended for trial in the control of lice on soldiers and civilians in typhus fever areas."

Scoular, Florence I., and Helen Willard, "Effect of Refrigeration on Ascorbic Acid Content of Canned Fruit Juices after Opening," *J. Amer. Diet. Assoc.*, 20, pp. 223-225 (April, 1944).

The four canned fruit juices tested, grapefruit, orange, pineapple, and apple gave ascorbic acid and values of 29.9, 34.6, 9.8, and 1.7 mg. per 100 gm. respectively. The average percentage loss of ascorbic acid from freshly opened cans was 3.0 for grapefruit, 3.7 for orange, 1.1 for pineapple, and 24.1 for apple juice, after one day of refrigeration. The refrigeration of large (46 oz.) freshly opened cans of grapefruit juice for 3 days resulted in an average loss of 5.6 per cent. The ascorbic acid lost by each of the canned fruit juices during refrigeration was similar for the 3 methods of storing: covered with oiled silk refrigerator dish cover, in the open can, and in a glass jar with a lid but no rubber. The amount of head space in the can had no apparent effect upon the amount of ascorbic acid lost during storage.

These workers feel that grapefruit juice is the most economical purchase from the standpoint of ration points, money value, and relation of ascorbic acid during storage.

Holmes, Arthur D., "Effect of Pasteurization on the Riboflavin Content of Milk," *J. Amer. Diet. Assoc.*, 20, pp. 226-227 (April, 1944).

Herd milk produced under controlled feeding and management conditions by five breeds of normal healthy cows was pasteurized by the holding and by the flash process. The riboflavin content of the raw and pasteurized milk was determined by the fluorescence method. The average values obtained were 1.46 mg. per liter before and 1.43 mg. per liter after pasteurization in the spray vat equipment; 1.52 per liter before and 1.49 mg. per liter after pasteurization in the coil vat equipment; 1.41 mg. liter before and 1.42 per liter after pasteurization by the flash method. The loss of riboflavin by the spray vat holding process and by the coil vat process was about 2%. No loss was obtained in pasteurization by the flash method. From the practical standpoint as much riboflavin will be obtained from milk recently pateurized as from the same milk just before pasteurization.

Kahn, Ruth M., and Halliday, Evelyn G., "Ascorbic Acid Content of White Potatoes as Affected by Cooking and Standing on Steam-Table," *J. Am. Diet. Assoc.*, 20, pp. 220-222 (April, 1944).

Mature and new potatoes can make a definite contribution in fulfilling the ascorbic acid requirement in the diet, if the method of preparation is taken into consideration. Steaming in the skin was the only method of preparation which resulted in no loss of ascorbic acid. Three 100 gm. new potatoes, when steamed in the skin, can take the place of an average-sized orange (100 gm.) in providing the necessary ascorbic acid. French fried potatoes as ordinarily prepared cannot be considered a reliable source of ascorbic acid. Baked potatoes lose 20 per cent of their ascorbic acid during baking, and the loss increased to 59 per cent after standing 43 minutes on the steam-table. Mashed potatoes and creamed potatoes lost 39 per cent of their ascorbic acid during steaming and 95 per cent after preparation and standing on the steam-table.

New potatoes have a markedly greater ascorbic acid content than do mature ones.

Lepokovsky, Samuel, "The Bread Problem in War and in Peace," *Physiol. Rev.*, 24, pp. 239-276 (April, 1944).

Extensive review of the situation in various countries, especially in England; arguments and evidence relating to the value of fortified white flour. Regardless of the value of fortification, it is far easier to build an adequate diet around whole wheat flour than white flour.—*Elizabeth Powell Salit.*

Pitts, G. C., F. C. Consolazio, and Robert Eugene Johnson, "Dietary Protein and Physical Fitness in Temperate and Hot Environments," *J. Nutrition*, 27:6 (June, 1944).

The effect of variation in the level of dietary protein upon the physical fitness and metabolism of three subjects was studied under both temperate and tropical conditions while reclining, standing, and marching. In successive periods of about 2 months each, the urinary nitrogen excretion in grams per day averaged 18.5 during the high protein period, 9.5 during the low protein period, and 12.9 and 13.5 during the normal periods before and after the experiment, respectively. There were only minor changes in body weight.

Physical fitness under temperate conditions showed no changes attributable to dietary protein level, nor did performance of intermittent work in either hot dry or hot moist environment. Metabolism while reclining and while standing during the high protein period was not significantly higher than during the low protein period. Metabolism while marching was slightly lower in the low protein period. However, as judged by actual performance in the heat, this was a physiologically insignifiant change. It is concluded that even though protein does have a high specific dynamic action, the theoretical objections heretofore raised against a high protein diet in hot environments are unjustified under the conditions of our observations. Protein intake may vary widely from 75 to 150 gm. daily without effect upon physical performance of intermittent work in the heat.—*The Wistar Institute.*

McIntire, Junis Merlin, Bernard Sylvester Schweigert, Edward John Herbst, and Conrad Arnold Elvehjem, "Vitamin Content of Variety Meats," *J. Nutrition*, 28:1 (July, 1944).

The thiamine, riboflavin, and nicotinic acid content of a variety of meats has been determined. Prepared meats were found to be a good source of vitamins; they contain about the same amounts as fresh muscle meats. Retention of these vitamins in some of the meats was studied during broiling, braising, and boiling. Greater amounts of all the vitamins were retained in the meat after broiling than after braising. In the case of boiling the vitamin retention in the meat was dependent on the cooking time. Broiling favored a higher total retention of thiamine than did braising. In nearly every case over 90% of the nicotinic acid and riboflavin was recovered in the meat and drippings.—*The Wistar Institute.*

BIOLOGY AND PHYSIOLOGY

Newburg, L. H., "Obesity," *Physiol. Rev.*, 24: pp. 18-45 (Jan., 1944).

I. Energy Metabolism. As compared with normal people, obese individuals have a higher basal metabolic rate, produce more heat, and metabolize more fat. They do not utilize foodstuffs to a greater extent; therefore to avoid loss of weight they must eat more than normal people. Failure to lose weight on a low-calorie diet is attributed to water retention which is merely a by-product of undernutrition.

II. Etiological Aspects. The mechanisms for the dissipation of energy are normal in obese individuals. The fundamental reason for a positive energy balance is to be found in the cause or causes of an excessive desire for food. Emotional difficulties, family habit, early training, affluence, and boredom are among the environmental influences producing too great a food intake. Some become obese because their energy expenditure is sub-normal. As people get older there may be less active occupation without a corresponding reduction of appetite.—*Elizabeth Powell Salit.*

Steggerda, Morris, *Charles Benedict Davenport: The Man and His Contributions to Physical Anthropology," Am. J. Phys. Anthrop.*, N. S. 2:2 (June, 1944).

In reviewing the work of Charles B. Davenport one becomes impressed with the uniformity of its pattern. In his youth he was interested in nature study and worked as a newspaper reporter and editor. During his manhood his entire time was devoted to scientific research, and the promotion of biological study. He was always eager to offer kindly advice to all his pupils and colleagues. Throughout his life no obstacle was insurmountable if he wished to accomplish a particular project. Dr. Davenport was by early training a zoologist, but his interest soon reached into the fields of genetics, eugenics, biometry, and physical anthropology. He introduced an Index for Body Build, and made studies on the development of the head, nose, and face. He also introduced specific statistical methods to be used in physical anthropology, and was untiring in his efforts to establish a uniform system of checking. In 1904 Dr. Davenport organized the Station for Experimental Evolution at Cold Spring Harbor, Long Island, of which he became director, holding this position until his retirement in 1934. He may be called America's leading eugenicist, and was the founder of the Eugenics Record Office. His chief interest was human heredity. At the time of his death at the age of 78, he was still contributing richly to various fields of science.—*The Wistar Institute.*

Comroe, J. H., "The Hyperpnea of Muscular Exercise, *Physiol. Rev.*, 24, pp. 319-39 (July, 1944).

After reviewing evidence for the control of respiration by various

mechanisms it was concluded that respiration is controlled not by reflexes alone, not by chemical stimulation of the medulla alone, but by the proper interaction of both factors.—*Elizabeth Powell Salit.*

PHYSICAL EDUCATION

Edgren, Dr. Harry D., "What Is Our Job? Let's Look at Some of the Facts," *Jour. of P. Ed.* (P. Ed. Society of Y. M. C. A.'s of N. A.), 41:3 (Jan.-Feb., 1944).

Dr. Edgren, Program Specialist in Sports and Recreation, U. S. O. National Headquarters, New York City, makes an analysis of the psychological and sociological factors involved when civilians enter the armed forces. He uses a dozen criteria in this analysis. These factors, incorporated into health, physical education, and recreation programs, assist young people to make more satisfactory adjustments when they enter the services.—*H. T. Friermood.*

Cureton, Dr. T. K., "Basic Principles of Physical Fitness for Adults (from the physical education point of view)," *Jour. of P. Ed.* (P. Ed. Society of Y. M. C. A.'s of N. A.), 41:3 (Jan.-Feb., 1944).

Dr. Cureton is in the process of securing complete reports on 2,000 adult men between the ages of 25-45 years to be used for developing adult standards of fitness for men. From a preliminary survey of some of his data already in hand, from a survey of literature on this subject, and from his own experience in this field he outlines 12 basic principles for adult physical fitness.—*H. T. Friermood.*

Wittich, W. J., "Physical Fitness Through Physical Education for the Victory Corps Program in High Schools of Wisconsin," *The Physical Educator,* (4:4), pp. 152-154.

Questionnaires were sent out to 170 teachers of physical education within the State of Wisconsin. Sixty-one questionnaires were returned and used in the study, representing 27 cities.

Before the Victory Corps Program, 50% of the schools reporting did not have participation in physical education for all students. In 47% of the cases the time allotment has been extended. More facilities and equipment have been provided in 39% of the cases reporting. Eighty-five per cent of the teachers seemed to be in favor of the more vigorous program of activities.

In approximately one-half of the cases it was reported that the attendance had improved since the introduction of the Victory Corps Program. Seventy-five per cent of the teachers reported that students desire *more* physical education. General student response has shown improvement according to 89% of the teachers. Sixty per cent of the teachers reported that they are happier in their work than formerly. Fifty-nine per cent were found willing to accept the Victory Corps Program as a permanent program. They contend that the program will also function as a peacetime program.

School authorities appear to show more interest than formerly, as do the professional men, in the new program.—*Carolyn Bookwalter.*

Kulcinski, Louis, "The Relation of Intelligence to the Learning of Fundamental Muscular Skills," *The Physical Educator,* 4:3, pp. 95-102.

The purpose of the study was to determine the effectiveness of superior, normal, and sub-normal intelligence quotients of 105 fifth- and sixth-grade boys and girls in learning selected fundamental muscular skills when the

same material was presented. Tumbling exercises were used as the fundamental muscular skills.

There was found a significant degree of learning by the superior group over the normal and sub-normal group, marked superiority of the normal group over the sub-normal group, and a high degree of superiority of the superior group over the sub-normal group. A definite and positive relationship exists between various degrees of intelligence of fifth- and sixth-grade boys and girls in learning of fundamental muscular skills, and this relationship can be measured. (Note: degree of relationship not given by the author).

Girls were found to be superior to boys in almost all items measured and compared. There was no difference between the sexes in the simple battery before training; a definite tendency favoring the girls in the superior group appeared in the simple battery after training; girls were found definitely superior to the boys in the difficult battery after training. Indications were found that girls were superior in learning the hardest exercises of both batteries, except in the sub-normal group where the girls were found to be inferior to the boys.

The retention test showed that the brighter the subject the more they learn, the more they forget and the more they retain.—*Carolyn Bookwalter.*

Bayley, Nancy, "Size and Body Build of Adolescents in Relation to Rate of Skeletal Maturing," *Child Development,* 14:2 (June, 1943).

A study of the bearing of skeletal maturing, as contrasted with chronological age, on growth in absolute size. The following conclusions are emphasized:

Early-maturing girls, as a group, are relatively large and late-maturing girls are small before 13 years; while after this age their relative sizes are reversed. For their skeletal ages, the late-maturing girls tend to be larger than average at all ages.

For their chronological age early-maturing boys are relatively large at all ages; late-maturing boys are small between the ages of 11 and 16.—*Willis Bodine.*

Meredith, H. V., and E. M. Meredith, "The Stature of Toronto Children Half a Century Ago and Today," *Human Biology,* 16 (May, 1944).

The typical Toronto school girl aged 12-13 years was 3½ inches taller in 1939 than in 1892; the typical boy of 14 was slightly less than 3½ inches taller in 1939. Average values are tabulated as percentiles 5, 25, 50, 75, and 95 for ages 6 to 14.—*Elizabeth Powell Salit.*

Keys, Ancel, Austin Henschel, Henry Longstreet Taylor, Olaf Mickelsen, and Josef Brozek, "Absence of Rapid Deterioration in Men Doing Hard Physical Work on a Restricted Intake of Vitamins of the B Complex," *J. Nutrition,* 27:6 (June, 1944).

Eight normal young men were maintained on a rigidly controlled regime of diet, physical work, and exhaustive tests for 40 days during which time for 14 days, they were on a diet providing, in mg. per 1,000 cal., 0.16 of thiamine, 0.15 of riboflavin, and 1.8 of niacin. All men received capsules daily which were placebos for 5 men and provided abundant supplements of the B vitamins for the other 3 men. During the 14 days of vitamin restriction the caloric intake averaged 4,640 cal. daily with an expenditure of about 4,800 cal. Comprehensive clinical and ophthalmological examinations as well as a carefully standardized series of special tests failed to reveal any deleterious influence of the vitamin restriction and hard work in spite of

other claims to the contrary. The special tests included 12 objective tests covering endurance, anerobic work, speed coordination, and muscle strength, as well as other tests covering biochemical and psychological details. The vitamin intakes and excretions were measured by direct analysis.—*The Wistar Institute.*

Eaton, Theodore Hildreth, Jr., "Modifications of the Shoulder Girdle Related to Reach and Stride in Mammals," *J. Morph.*, 75:1 (July, 1944).

Among the cursorial and graviportal mammals, loss of the clavicle is associated with the incorporation of the scapula into the functional fore limb, so that the stride is increased beyond what it would be if the scapula were fixed, and the swing of the fore limb synchronizes more effectively with that of the hind limb. Loss of the clavicle in aquatic orders of mammals appears to be related to freedom of movement of the scapula and flippers. Among the brachiating Primates the scapula and clavicle, pivoting respectively at the vertebral margin of the scapula, and the articulation with the sternum, become a proximal segment of the functional arm, by which the cephalocaudal reach of the arm is increased. These changes are the latest in a series of steps towards freeing the fore limb from functional limitations imposed by its primitive relations with the body skeleton; previous steps in this direction were taken during the fish-to-labyrinthodont and therapsid-to-mammal transformations.—*The Wistar Institute.*

EDUCATION

Gamble, David P., "Physical Type and Mental Characters. Preliminary Notes on the Study of the Correlation between Racial Types and Types of Psychotic Reaction," *Am. J. Phys. Anthrop.*, N. S. 2:2 (June, 1944).

Over 100 mental patients at Purdysburn Villa Colony, Belfast, were measured. These were classified into racial groups in accordance with a scheme previously worked out and a correlation table of the racial types and types of psychoses was drawn up. The patients selected were mainly schizophrenics or manic-depressives. Considerable space is devoted to the discussion of the racial types found in Ireland. An attempt was made to correlate individual measurements and indices with the types of psychotic disorder. In general, with the exception of weight, the correlations were absent or so low as to be unsatisfactory. As weight would appear to be a partial function of race, occupation, age, health, nutrition, time of year, etc., its correlation with the psychoses may not be significant. On the other hand, the high correlations between certain types of psychoses and certain racial types together with the factors of age, and development, suggest that the constitutional aspect is of prime importance. The exploratory nature of this study is emphasized.—*The Wistar Institute.*

Punke, Harold H., "Home Background of High School Youth," *J. of Educ. Res.*, 37:4 (Dec., 1943).

A study was made of the social and economic aspects of the home background of high school senior and freshman youth in high schools with an enrollment of 150 to 500 pupils. From one thousand, six hundred, forty-four to two thousand and seven pupils responded to the questionnaire from each of nine states.

Data were included relating to size and type of household, size of family, marital status of older siblings, and family unity.

In comparing the study of seniors with that of the freshmen it was found that, (1) seniors in general live in larger homes than freshmen,

(2) seniors as a whole come from somewhat smaller families than do freshmen, and (3) twenty to twenty-five per cent of older unmarried siblings do eat and sleep at home.—*Helen Coleman.*

Reynold, Floyd Johnson, "Factors of Leadership among Seniors of Central High School of Tulsa, Oklahoma," *J. of Educ. Res.*, 37 : 5 (Jan., 1944).

Data for the study were gathered from cumulative records of eight hundred and eighty-eight graduating seniors who had completed six semesters of study in the Tulsa High School. Four and thirty-seven were designated as leaders and four hundred fifty-one as non-leaders. Leadership was based on the number of points earned as officers of clubs, committee services, captaincy of athletic teams, etc., in all school programs. Point values of activities were established by the faculty.

Coefficients of correlation were calculated between total leadership and each of the factors of scholastic achievement, personality traits, and heights of the individuals.

Finds of the Tulsa study agreed substantially with the factors found in other similar investigations.

It was found that leaders tend to excel in scholarship, to have more definite personality traits, and that height was not a significant factor.—*Helen Coleman.*

Haggard, E. A., and G. J. Rose, "Some Effects of Mental Set and Active Participation in the Conditioning of the Autokinetic Phenomenon," *J. of Exp. Psy.*, 34 : 1 (Feb., 1944).

A study to determine whether the autokinetic pheonomenon could be conditioned in human subjects; and, if so, what would be the effects of differences in mental set and degrees of active participation.

A bulb was placd in a tin can, one side of which was pierced with a pin-point hole. The subject sat 10 feet away in a blacked-out room. The 16 subjects were divided into 2 groups, active and passive. Those in the passive group were required to report whether the light moved and if so in which directions. Those in the active group, in addition to reporting whether the light moved, were required to draw an arrow the same length and in the same direction as the perceived movement. Four of the active and four of the passive subjects were told the light would move during most of the trials. The others were told that it would move during some of the trials. All subjects were rewarded for "perceiving" movement to the left, and punished for "seeing" movement to the right. Actually the light did not move.

The active group "saw" the light move farther and more frequently. They were more affectively conditioned to see it move to the left, and more confident that their perceptions were correct. This was also true of the subjects who were told the light would move during most of the trials.

The authors postulated the following Law of Active Participation to account for certain findings of the experiments when an individual assumes an active role in a learning situation: (a) a subject tends to acquire the responses-to-be-learned more rapidly, and (b) these response-patterns tend to be more stably formed than when a subject remains passive.—*E. Johnston.*

Smith, Helen Hebel, "The Santa Barbara Behavior Rating Scale: Its Development and Use as an Evaluation Instrument in a Program of Guidance," *Jl. of Educ. Res.*, 37 :7 (March, 1944).

The Santa Barbara Behavior Scale was developed in an attempt to evaluate students in effective adjustments in their behavior in the environments of the school. It was developed in 1935 and used during the five-year period of curriculum revision. It was used "to identify changes in behavior and to appraise the nature of such changes." The purposes of the scale were: (1) to supply a usable form for satisfactory results, (2) to evaluate progress toward attainment of educational objectives, (3) to evaluate revised curriculum. The five-point ratings were made in areas of critical mindedness, resourcefulness, prudence, and spiritual mindedness. They were recorded after a five-week observational period. The coefficient of reliability of the first application of the scale was .50. The scale was revised in 1942. No coefficient of reliability was quoted for the revised scale.—*Helen Coleman.*

DiMichael, Salvatore G., "Comparative Changes in Teachers' Attitudes Resulting from Courses in Mental Hygiene and Educational Guidance," *J. of Educ. Res.*, 37:9 (May, 1944).

The author states that the teacher's attitudes play a major part in the development of the child and the psychologists, parents, mental hygienists, guidance counselers, and administrators are concerned with the part these attitudes play in the child's development. A study was made of 44 experienced teachers who were members of Mental Hygiene and Educational Guidance classes of Saint Louis University for the six weeks' period of the summer session of 1941. Wichman's Behavior Rating Scale was used at the beginning and end of the courses. It was found the Educational Guidance course did not change to a noteworthy extent the attitudes of the experienced teachers. There was an appreciable change of attitudes of those in the mental hygiene classes in regard to withdrawing, aggressive behavior, and the changes in the mental hygiene classes were in the direction of greater conformity with mental hygienists.

The author believes there is need of fuller understanding of behavior upon personality development, and that courses considering the nature of the child inculcate the modern viewpoint of human behavior. "Psychological point of view must be harmonized with the individual's personal and social nature."—*Helen Coleman.*

Hill, George E., "Teacher's Instructional Difficulties—A Review of Research," *J. of Educ. Res.*, 37:8 (April, 1944).

This review attempts to cover a fair sampling of studies made of teachers' instructional difficulties from the years between 1927 and 1941 in limited areas of problems relating directly to classroom teaching. It was found that most of the studies dealt with rural or beginning teachers. The methods used in the researches were mostly self-reporting; nearly one-half of the reports depended upon teachers' informal reports of the problems. The methods used in the researches consisted of (1) informal reports, (2) prepared check lists for instructional problems, (3) oral discussions, (4) supervisors' reports, and (5) daily logs or diaries. The author concludes that though there is considerable literature there appears to be a lack of adequate control in self-reporting and that recent attempts in indirect measuring by supervisors appears to be a better means; futhermore, that teacher's experiences outside of the school room cannot be segmented from life inside the classroom.—*Helen Coleman.*

Thomas, Lawrence G., "Using Grade Averages in Selecting Prospective Teachers," *J. of Educ. Res.*, 37:9 (May, 1944).

The committee on teaching credentials of the school of education at Stanford University has the problem of selecting and evaluating students for recommendations for California General Secondary Credentials. This study was concerned with the grade averages as summarizing the academic progress and competence as one of the types of evidences of teaching ability. A study was made of 150 former students receiving secondary credentials, and the subjects taught by them. Seventy-one per cent taught at least one subject in a major field; 42 per cent taught at least one subject in a minor field; and 33 1/3 per cent of the physical education and health majors taught a subject out of their major and minor fields. It was concluded that the averages of the major and minor fields need to be considered separately; also there is a need for further study of grade averages and their meanings as adequate measures for competence in later teaching.—*Helen Coleman.*

Symonds, Percival M., "The Needs of Teachers as Shown in Autobiographies II," *J. of Educ. Res.*, 37:9 (May, 1944).

This study is a supplement to the report of the needs of the fifty teachers as studied by analysis of autobiographies published in the May, 1943, issue of *The Journal of Educational Research.* The preceding report included the needs of achievement, affiliation, and infavoidance. The present study includes a discussion of three additional needs: autonomy, cognizance, and blameavoidance. The need for autonomy appeared in 36 of the 50 autobiographies, cognizance in 31, and blameavoidance in 30 of the fifty cases. —*Helen Coleman.*

Boyce, Robert V., and Roy C. Bryan, "To What Extent Do Pupils' Opinions of Teachers Change in Later Years?" *J. of Educ. Res.*, 37:9 (May, 1944).

More than one thousand questionnaires were sent to students in colleges, high school teachers, elementary school teachers, and parents of school children, in an attempt to determine the changes in opinion concerning former teachers. The questionnaire presented two judgments, namely, the best and the poorest, with spaces for comments. Ninety-five per cent of those rated as the best teachers were rated highest or next to highest in retrospect. If the scale can be trusted, only a small minority change their opinions of teachers and to predict the way pupils will feel later toward teachers, it is necessary to know their present attitudes.—*Helen Coleman.*

Editorial Policies

THE Editorial Committee has approved the following policies for the publication of material in the *Quarterly*:

1. Manuscripts should be sent to the Editor who will see that each one is read by at least two members of the Board of Associate Editors. The Editor will advise the author as to the suitability of the paper or the desirability for revision.

2. Papers are not judged by arbitrary standards of length but on their content of new research results in the field of physical education, health education, and recreation, presented with the greatest brevity compatible with scientific accuracy and clarity.

3. Since manuscripts will not be insured against loss or damage, authors are expected to retain duplicate copies of all material submitted.

4. An original typewritten copy of the manuscript should be submitted. The content should be double spaced with a margin of 1½ inches on each side.

5. The author may include either a list of references at the end of the article or he may put them in footnotes or these two methods may be combined. Book publishers and periodicals do not always agree on the exact order of details in the preparation of references. Also, authors do not always include all the necessary information in references. For authors who have not published extensively a simplified form for magazine and book references is shown. If a formal bibliography is included with the paper a simple footnote may be used if the author wishes.[1]

In this instance the bibliography and not the footnote shows the "facts of publication"—edition if any, place published, publisher, date.[2, 3]

The second and third reference examples may be used (1) in a bibliography in which case all the references are listed alphabetically at the end of the paper, or (2) as a bibliographical footnote showing the "facts of publication" in parentheses in which case they are placed on the corresponding pages as the article progresses.

When there is more than one author, the names are written with the Christian names or initials first in all cases except the first one when the last name appears first.[4]

Footnotes should be separated from the text by lines running across the page. They should be inserted at the point in the page where the reference occurs.

---

1 Crisp, Katherine B., *Health for You*, p. 520. (books)

2 Stern, Frances. *Applied Dietetics*. Baltimore: Williams and Wilkins Company, 1943. Pp. x plus 29. (books)

3 Corbin, H. D., "Current Problems in Recreation," *Journal of Health and Physical Education*, 15:6 (June, 1944), pp. 315-16, 353-54. (magazines)

4 Kraines, S. H., and E. S. Thetford. *Managing Your Mind*. New York: The Macmillan Company, 1944. Pp. viii plus 374.

Although this form is preferred in the *Quarterly*, authors may submit articles with references prepared differently provided the essential information is given and the style used is that of well known journals.

There are many sources of information relative to the preparation of manuscripts for publication. A good source is *A Manual of Style* (10th Edition), Chicago, University of Chicago Press, 1937.

6. Charts, graphic tracings, etc., are required in many instances and best results are obtained by photographs of the size desired in reproduction and printed on glossy paper. Either originals or photographs may be submitted. Only those figures which aid in clarifying the article should be included. Authors are required to pay for cuts appearing in the *Quarterly*.

7. Tables and illustrations should be prepared with the size (4⅛ x 7 inches) of the *Quarterly* type page in mind, with the idea of conserving vertical space.

8. All illustrative material must be submitted in such form as to admit of photographic reproduction without retouching or redrawing. Plotted curves, guide lines, lettering, etc., should be done in india ink. Lettering should be large enough to be legible if illustrations have to be reduced in the process of making a cut.

9. Duplication of data in tables, charts, and protocols is not believed to be generally necessary. Too extensive use of such material is discouraged.

10. From time to time, the Editor may make requests for reviews and bibliographies. In this event, authors will be advised as to the amount of material desired.

REPRINTS FROM THE RESEARCH QUARTERLY

(1938 to date)

Reprints are available from the national office, 1201 16th St., N.W., Washington 6, D. C., for 10c each. Please order by number. All orders must be accompanied by funds.

1938

Q 188 The Validity of the Pulse-Ratio Test of Cardiac Efficiency. Henry and Kleeberger.
Q 193 A Fall Decathlon for Track Squads. Cozens.
Q 194 Convenient Apparatus for Study of Motion Picture Films. Glassow, Broer.
Q 199 The Reliability of the Pulse-Ratio Test. Henry and Farmer.

1939

Q 201 Behavior Pattern of Throwing. Wild.
Q 203 Effect of Exercise, Fatigue and Exhaustion on the Electrical Potential of the Brain Cortex and Threshold of the Knee Jerk. Burge *et al.*
Q 204 Angles in Measuring Leg Lift Carpenter.
Q 206 Use of A Belt to Measure Leg Strength. Everts.
Q 207 Rating Profile for Student Teachers. Brown.
Q 208 Educational Responsibilities Outside the Classroom of Women Instructors of Physical Education in the State of Indiana. Schwehn.
Q 210 Recent Studies of American Adolescents. Cassidy.
Q 211 Studies of the Johnson Test of Motor Educability. Metheny.
Q 212 Food Habits of Sixth and Seventh-Grade Children. Peterson.
Q 213 A Study of Falls in Skiing. Smart.
Q 214 Studies in Measuring Basketball Playing Ability of College Women. Glassow, Colvin, Schwartz.
Q 215 Exercise and Heart Disease. Deaver.
Q 217 Examinations of New High School Students in the Public Schools of Seattle. Wade.
Q 218 A Study of the Standardization of Exercise for Use in the Pulse-Ratio Test. Tuttle and Charlesworth.
Q 225 U. of M. Study of Physical Education Facilities and Equipment. Nordly.
Q 226 Vital Capacity in Trunk Deformities. Hansson.
Q 227 The C.C.C. as a Builder of Physical Fitness in Youth. Walker.
Q 228 Status of Physical Education for Boys in High Schools for Negroes in Texas. Codwell.
Q 229 Effect of the Elimination of the Center Jump. Frigard.
Q 230 Comparative Recreational Values of Volleyball and Selected Activities for College Women. Crosslin.
Q 231 Study of Teaching Difficulties in Physical Education. Graybeal.
Q 232 Sociological Contributions of Physical Education to the Needs of the Negro. Bell.
Q 234 Experimental Analysis of Running and Differences in Runners. Hubbard.
Q 235 The Development of Public Recreation in Metropolitan Chicago. Halsey.
Q 237 Respiration in Swimming and Diving. Karpovich.
Q 239 Improving the Construction of the Essay and Objective Examination. Hewitt.

Q 240 Status of Health and Physical Education on Requirement for Men Students. McCristal and Miller.
Q 241 An Experiment in Self-Directed Study for College Freshmen. Guernsey.
Q 242 Proportions of Negro and White Male Students as Related to Athletic Performance. Metheny.
Q 243 Standards for Testing Beginning Swimming. Cureton.

1940

Q 246 Correlations of Measurements of Men Students. Ilsley.
Q 247 Rhythmics in Music and Dance. Hellebrandt.
Q 248 The Effect of Football and Basketball on Vision. Tussing.
Q 249 Prediction of Time in Swimming Based on Oxygen Consumption. Karpovich and LeMaistre.
Q 250 Comparison of the Rogers Test and the C.C.N.Y. Test as Bases for Classifying Students. Sperling.
Q 251 A Study of the Primary Components of Cardiovascular Tests. Murphy.
Q 252 Prediction of the Advent of the Menarche from Height and Weight. Shuttleworth.
Q 253 Analysis of the Basic Factors Involved in Fancy Diving. Lanoue.
Q 254 Study of the Optimum Time for Holding A Swimmer on His Marks. Tuttle and Morehouse.
Q 255 Strength Tests as Measures of General Athletic Ability. Cozens.
Q 256 The Evaluation of Boxing as a College Activity. Thacker, Kenny, Gebhart.
Q 257 Characteristic Positions in the Field of Aquatics. Clemenger.
Q 258 The Present Status of Physical Indices. Powell.
Q 259 A Preliminary Study of Factors in Motor Educability. McCloy.
Q 260 Pure Speed as a Factor in Some Track and Field Events. Coleman.

1941

Q 261 Social Values of a Team Game and Individual Sports. Hazelton.
Q 262 Intramural Athletics for Men in Negro Colleges. Taylor.
Q 263 A Study of Response Time Before and After Strenuous Exercise. Elbel.
Q 264 Decade of Research in Aquatics at Springfield. Cureton.
Q 266 Circulatory-Respiratory Measures as Index of Endurance. McCurdy and Larson.
Q 267 Coefficient Performance Chart. Jefferson.
Q 268 Chest-Height-Weight Tables for College Women. Powell and Ludlum.
Q 269 Short Cuts in Working Out Intercorrelations. Carpenter.
Q 270 Anthropometric Study of Negro and White Women. Steggerda and Petty.
Q 271 Hypersensitiveness to Cold in Swimmers. Horton and Gabrielson.
Q 272 Health and Physical Education in Secondary Schools. Irwin and Reavis.
Q 273 Survey of Student Recreation in Colleges and Universities. Daniels.
Q 274 Learning Problems in Student Teaching. Brown.
Q 275 The Philosophical or Group Thinking Method of Research. Cureton.
Q 276 Some Factors Involved in Performance in Bowling. Webster.
Q 277 Determination and Measurement of Body Build in College Students. Jorgensen and Hatlestad.

Q 278 Proportion Charts for the Adult Female. Bowman, Wilson and Wilson.
Q 279 Comparative Analysis of the Physical Education Background, Interests, and Desires of College Students as an Evaluation Procedure. Beise.
Q 280 Effect of Training and Competition on the Response of Hearts. Tuttle and Walker.
Q 281 Analysis of Strength Variables and Tests with a Test Combination. Larson.
Q 282 Relation of Height and Weight Measurements to Intelligence and to Dominance-Submission Among a Group of College Freshmen. Middleton and Moffett.
Q 283 Effect of Gelatin on Work Output. Kaczmarek.
Q 284 The Integrated Post-Exercise Pulse-Product as a Measure of Physical Fitness. Kelley.
Q 285 The Status of the Effect of Gelatin on Muscular Fatigue. Tuttle and Byer.
Q 286 Race and Stature: A Study of Los Angeles School Children. Jones.
Q 287 An Analysis of the Relationships of the Factors of Velocity, Strength, and Dead Weight to Performance. Carpenter.
Q 288 The Factor Analysis as a Research Technique. McCloy.
Q 289 The Status of Student Health Programs in Negro Colleges. Cornely.
Q 290 The Best Method of Manual Artificial Respiration. Karpovich.
Q 291 Studies in Learning Gross Bodily Skills. Brace.
Q 292 Some Correlations Between Health, I.Q., Extracurricular Activities and Scholastic Record. Hinrichs.
Q 293 Skeletal Symmetry in High Jumping. Krakower.
Q 294 Study of Effects of Competitive Basketball on Physical Fitness. Boys and Olds.
Q 296 Study of Scholastic Attainment of Letter Winners. Tuttle and Beebee.
Q 297 Respiratory Habits of Trained Swimmers During Start. Morehouse.
Q 298 College Hygiene Courses. Montgomery.
Q 299 Evaluating Team and Individual Performance in Basketball. Elbel and Allen.
Q 300 Factor Analysis of Motor Ability Variables and Tests. Larson.
Q 301 Anthropometry of Young Women. Bell, Beise, and Hughes.
Q 302 The Measurement of Postures. Buhl and Morrill.
Q 303 Relationships between Certain Phases of Kinesthesis and Performance. Phillips.
Q 304 A Consideration of Qualities Used by Administrators in Judging Effective Teachers of Physical Education in Minnesota. Graybeal.
Q 305 A Survey of Safety Conditions of Buildings and Grounds of Secondary Schools. Irwin.
Q 306 A Fifty-nine Year Survey at Yale Reveals Freshmen are Becoming Younger, Heavier, and Taller. Deegan.
Q 307 An Anthropometric Study of Masculinity and Femininity of Body Build. Carpenter.
Q 308 A Preliminary Study of the Validity and Reliability of the City College Physical Proficiency Test. Ehrlich.

1942

Q 314 The Relation of "Quickness of Bodily Movement" to Success in Athletics. Keller.
Q 318 An Evaluation of the Physical Status of City College Students on the Basis of Two Standardized Tests. Ehrlich and Sperling.

Q 320 Athletes as Blood Donors. Karpovich and Millman.
Q 321 Physical Education as a Profession. C. O. Jackson and Committee.
Q 325 Body Measurements on One Hundred Male Negroes. Steggerda and Petty.
Q 328 Brace Scale Used with Young Children. Vickers, Poyntz, and Baum.

1943

Q 334 Action Current Study of the Rectus Abdominalis as a Postural Muscle in Arm Movement. Slater-Hamel.
Q 339 Relation of Selected Structural and Functional Measures to Success in College Athletics. DiGiovanna.
Q 342 Determination of the Weight and Size of a Standard Discus for College Women. Tuttle.
Q 343 Evidence of A Science of Recreational Guidance. Lentz.
Q 344 Body Weights Optimal for Young Adult Women. Turner.
Q 346 An Analysis of Certain Factors in the Gait of College Women. Grace.
Q 347 Yale University Completes One Year of Its Wartime Physical Training Program. Wickens and Murphy.
Q 348 War Emergency Certification in Physical Education in the United States. Cobb and Landreth.
Q 349 Validity of Football Achievement Tests as Measures of Motor Learning and as a Partial Basis for the Selection of Players. Brace.
Q 350 Military Athetics at the University of Illinois. Johnson.
Q 351 Construction of Knowledge Tests in Selected Professional Courses in Physical Education. French.
Q 352 Achievement Scales Scores for Wartime Swimming. Hewitt.

1944

Q 353 A Study of Mortality Among the Men Who Have Played in the Indiana State Final Basketball Tournaments. Wakefield.
Q 354 The Andover Physical Fitness Testing Program. Gallagher, Schubert, Peck, and Johnson.
Q 355 Physiological Maturity as a Factor in the Qualification of Boys for Physical Activity. Espenschade.
Q 358 Study of Circulatory-Respiratory Changes as Indicated by the McCurdy-Larson Organic Efficiency Test in Relation to Physiological Age. Dane.
Q 359 What the Public Knows About Nutrition. Kilander.

AMERICAN ASSOCIATION FOR HEALTH, PHYSICAL EDUCATION, AND RECREATION

Board of Directors

President, William L. Hughes, Teachers College, Columbia University
President-Elect, Helen Manley, Public Schools, University City, Mo.
Past-President, A. H. Pritzlaff, Board of Education, Chicago
Vice-President (Health Education) Dorothy Nyswander, Office of Coordinator of Inter-American Affairs, Washington, D. C.
Vice-President (Physical Education) Harry A. Scott, Brooklyn College, Brooklyn, N. Y.
Vice-President (Recreation) Carl L. Nordly, University of Minnesota, Minneapolis
Exec. Sec.-Treas., Ben W. Miller, 1201 16th St., NW., Washington 6, D. C.

District Association Presidents

Central: Germaine Guiot
Eastern: George Ayars
Midwest: Robert Nohr, Jr.
Northwest: Lestle Sparks
Southwest: O. K. Cornwell
Southwest: Glen Worthington

Additional Members of Representative Assembly

Administration and Supervision: Alfred Anderson
Alabama: William R. Battle, Jr.
Amer. Acad. of P. E.: Arthur Steinhaus
Amer. Physiother. Assn.: Ellen Kelly
Amer. School Health Assn.: C. H. Keene
Arizona: Catherine A. Wilkinson
Arkansas: Ivan Grove
Boys Clubs of America, Inc.: Walter M. Hall
California: C. L. Glenn, Louise Cobb, Eleanor Metheny, Verne Landreth
Camping and Outing: Ross Allen
Canadian P. E. Assn.: A. S. Lamb
College and University Physical Education for Men: Glenn Howard
College and University P. E. for Women: Laura Huelster
College P. E. Assn.: O. K. Cornwell
College Recreation: Harriett Aull
Colorado: Granville Johnson
Conn.: Herbert Walker, Marjorie Zang
Dance: Ruth Bloomer
Delaware: G. W. Ayars
Delta Pai Kappa: Margaret McCall
Dental Health: Randolph G. Bishop
District of Columbia: Isabel Chappell
First Aid and Safety Education: Irma Gene Nevins
Florida: Katherine Montgomery
Georgia: Thomas McDonough, Gertrude Manchester
Health Instruction: Rosemary Kent
Idaho: (None)
Illinois: Iris Boulton, C. O. Jackson, Nellie Cochran, Bessie Specht
Indiana: Clara Hester, Reuben D. Behlmer
Industrial Recreation: John Ernst
Institutional Recreation: (To be appointed)
Intramural Athletics: Milton R. Howard
Iowa: Jane E. Harris, D. A. Armbruster
Kansas: Edna McCullough, Oran Shearer
Kentucky: Mary May Wyman
Louisiana: Frank J. Beier, Jess W. Hair
Maine: Louis Hutto
Maryland: Louis R. Burnett
Massachusetts: Ruth Evans, Nelson Walke
Men's Athletics: Everett S. Dean
Mental Health: Alfred Kamm
Measurement and Evaluation: Don Minnegan
Michigan: Margaret Bell, Vaughn Blanchard
Minnesota: Harold K. Jack, Glen Calligan
Mississippi: John J. Read
Missouri: Helen Manley, Ruth Ann Frazier
Montana: (None)
Municipal Recreation: (To be appointed)
National Association of P. E. for College Women: Elizabeth Halsey
National Col. Ath. Assn.: F. W. Luehring
Nebraska: James Lewis
Nevada: (None)
New Hampshire: Maurice O'Leary
New Jersey: Arthur Morr, Martha Lahey
New Mexico: Jere K. Reid
New York: Ellis Champlin, H. Harrison Clarke, Elmon Vernier, Ethel T. Kloberg
North Carolina: Julia Grout
North Dakota: Louise Reishus
Ohio: Delbert Oberteuffer, John Van Why, Paul Landis
Oklahoma: Valerie Colvin
Oregon: Lestle Sparks
Park Recreation: Milo P. Christiansen
Pennsylvania: C. Lawrence Walsh, Lloyd M. Jones, G. W. Mueller
Phi Delta Pi: Bernice Moss
Phi Epsilon Kappa: Wilbur DeTurk
Private Recreation: Harold L. Kistler
Private School P. E.: T. John Johnson
Professional and Public Relationships: Ralph A. Piper
Professional Education: Mabel Rugen
Public School Physical Education: Joseph Burns
Research: Karl W. Bookwalter
Rhode Island: Bessie H. Rudd
School Nursing: Mildred Coyle
School Nutrition: Melva Bakkie
School Physicians: Charles C. Wilson
School Recreation: Carl A. Troester
Society of State Directors: Frank S. Stafford
South Carolina: Alice Dent
South Dakota: (None)
Student: Lucille Brahms
Tennessee: Bernice Iddins
Texas: P. C. Cobb, Harry A. Scott
Therapeutics: Mrs. Ivalclare S. Howland
Utah: Leona Holbrook
Vermont: Alice C. Aldrich
Virginia: Martha Barksdale, E. V. Graves
Washington: G. Spencer Reeves, Edwin A. Graham
West Virginia: Randolph Webster
Wisconsin: William C. Pickett, Jane E. Whitney
Women's Athletics: Anna Espenschade
Wyoming: (None)
Y.M.C.A. Phys. Dirs. Society: R. E. Laveaga
Y.W.C.A. Health Education Directors Society: Edith M. Gates